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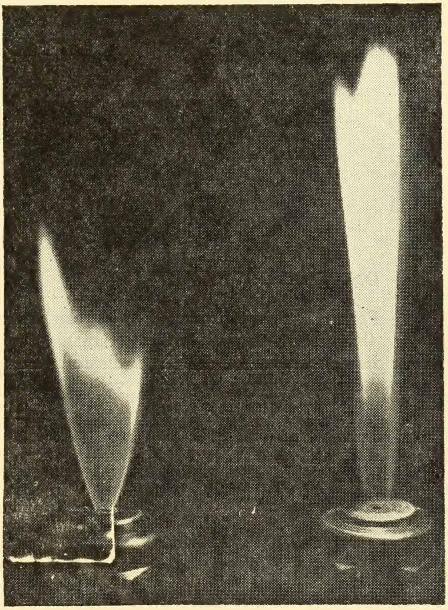
BULLETIN 545 JULY 1956

Flame Cultivation



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ON THE COVER:

Figure 2. Flame produced by regular spray nozzle (left) and round orifice (right). The shorter flame pattern on the left indicates more efficient combustion than the long yellow flame on the right.

FLAME CULTIVATION

By E. B. WILLIAMSON, O. B. WOOTEN, F. E. FULGHAM[1]
Delta Branch Experiment Station, Stoneville, Miss.

The search for an effective and labor-saving method of controlling weeds in cotton and other row crops in recent years has resulted in the use of numerous mechanical and chemical weed-killing devices. One practice that has warranted a great deal of investigation is the process of applying a hot blast of flame to weed-infested crops. Although this relatively new method of weed control has met with varying degrees of success since its introduction in the late 1930's, it has to a limited extent, proved economical and useful in the development of mechanized cotton-production programs in some areas.

The first flame cultivator tested at the Delta Branch Experiment Station was a rather cumbersome, sulky-type rig, equipped with air compressor, gasoline engine, cone-shaped burners, and an assortment of valves, fuel lines, and other accessories. The flame was produced from a mixture of fuel oil and air.

Improvements were made in 1944 by mounting the machine on a tractor and utilizing the power take-off rather than a separate gasoline engine for operating the compressor. An ignition system, consisting of a distributor and automotive-type spark plugs placed in each burner, was also added to provide more uniform operation. Although these and other improvements by manufacturers and research workers greatly increased the efficiency of the early machines, more important developments were yet to come.

The Principle of Flame Weeding

Eradication of weeds in cultivated crops by flaming is a selective process. Different kinds of plants are able to withstand differing amounts of heat, depending upon their stem structure, age, size, and shape. Control of unwanted plants by this method of cultivation is therefore accomplished by moving an intense blast of flame along the base of the weed-infested crop. Growth is impeded or terminated in those plants having the least resistance to the high temperatures induced by the flame burners. When sufficient heat has been introduced to cause dehydration and rupture of cell walls, the plant dries and the process of destruction is completed.

The intensity and volume of the flame and duration of exposure are important factors in attaining effective results with flame. Desired exposures are obtained by varying the speed of the tractor, while the size and velocity of the flame pattern may be varied by changing the burner orifice and fuel pressure. The position of the burner in relation to the weeds is also highly important, since the most effective kills are obtained by destroying the buds of the plants. When weeds are as tall as the cultivated crop, they cannot be destroyed with flame without causing excessive damage.

New Developments

Flame cultivation, as we know it today, began with the introduction of the L-P gases, butane and propane, as fuel in 1945. The round, Barr-type, L-P gas burner was also introduced at that time and was subsequently adopted by most manufacturers. A self-energizing burner, which utilized heat from the burner flame in vaporizing the liquid-petroleum fuel, was also developed and used in some machines.

Although additional modifications and improvements in machine design followed these developments, flame cultivation failed to gain in popularity in the Cotton

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[1] Agricultural Engineers, Delta Branch of the Mississippi Agricultural Experiment Station, and Farm Machinery Section, Agricultural Engineering Research Branch, ARS. USDA. Stoneville, Mississippi, cooperating.

Belt. Much of the reluctance in using flame in cotton stemmed from the realization that this practice would not completely solve all grass and weed problems. Some farmers considered flame too limited in its usefulness in controlling weeds in young cotton, the time when hand labor is usually in greatest demand. Failure to adopt production practices compatible with flame cultivation and rising fuel costs were other factors that retarded the use of this new weed-eradication device.

The Flame Cultivator

The components of a typical flame cultivator are shown in the schematic diagram in figure 1. They consist of a high-pressure tank, tank fittings, vaporizer, fuel lines, quick cut-off valve, pressure regulator, pressure gauge, rockshaft, attaching frame, skid assembly, burner supports, and burners.

The fuel tank should be equipped with brass fittings and both tank and fittings must meet certain code specifications of the A.S.M.E. for handling butane and profane fuels. Each tank must be stamped with the State Inspector's approval.

As illustrated in the diagram, the necessary tank fittings include a filler valve, safety relief valve, fuel level gauge, pressure gauge, 85-percent-full indicator, vapor return valve, and liquid withdrawal valve. The filler valve is equipped to open automatically when the filler hose is connected and to close instantly as the hose is removed. The cap covering this valve should always be screwed in place as soon as the filler hose is disconnected.

The safety valve, which functions to relieve excessively high pressures, should be in good operating condition at all times and should be repaired or replaced only by a competent serviceman.

Either a slip-stick or dial indicating type fuel-level gauge may be used for determining the amount of fuel in the

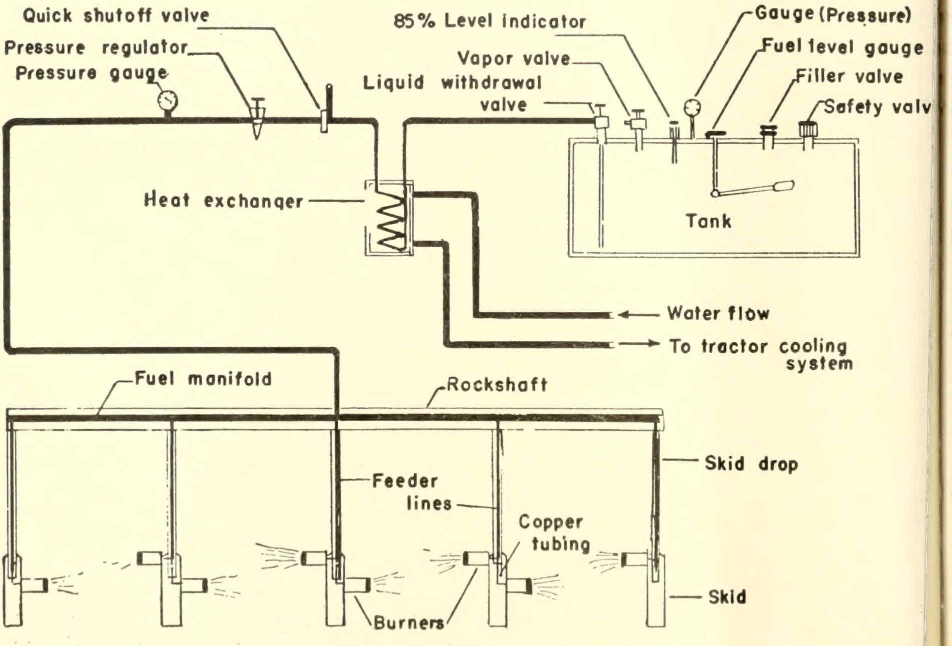
Quick shutoff valve
Pressure regulator
Pressure gauge
85% Level indicator
Vapor valve
Liquid withdrawal valve
Gauge (Pressure)
Fuel level gauge
Filler valve
Safety valv
Heat exchanger
Tank
Water flow
To tractor cooling system
Fuel manifold
Rockshaft
Skid drop
Feeder lines
Copper tubing
Burners
Skid

Figure 1. Schematic diagram of a flame cultivator.

tank. The dial type, which is actuated by a float, requires only a quick glance to read.

The high-pressure gauge, which indicates the tank pressure at all times, should be mounted in conjunction with a check value so that the flow of fuel from the tank will be stopped should the gauge be broken. The 85-percent liquid-level indicator prevents the tank from being filled beyond its maximum allowable capacity.

The function of the vapor return valve is to provide connection of the vapor space at the top of the fuel tank with the vapor space at the top of the storage tank. This allows pressures in the two tanks to equalize during the filling operation. The liquid withdrawal valve permits the flow of liquid from the tank to the vaporizer and thence to the burners.

Although a vapor valve is used at the top of the fuel tank to supply gas to the burners in some two-row flame cultivators, the normal practice is to withdraw liquid from the bottom of the tank and vaporize it before it reaches the burners. In this process, water is circulated from the cooling jacket of the tractor engine around a coiled section of the fuel feeder line and returned to the tractor radiator. When the tractor is not equipped with a water pump, an auxiliary pump may be installed and driven either with a longer belt from the fan or from the power take-off.

After vaporization, the gas is conducted through a pressure regulator to a manifold where it is then channeled to the individual burners. A quick-opening valve, installed in the line ahead of the regulator and within easy reach of the tractor operator, should have a small hole drilled in the gate to allow a pilot light to burn while the burners are off for turning at the ends of the field.

The burners, which are normally mounted on skids, are connected to a rockshaft by means of a rigid arm, hinged at both ends. The skids operate in the center of each row middle and support either one or two burners, as shown in figure 1. The height of the burners above the ground is controlled by adjustments on the skid assemblies. Although a rubber hose is used to convey the fuel from the tank to the manifold, a short length of small copper tubing is used in the individual lines near each burner as protection against the burner flame.

An Experimental Machine

Significant developments in machine design in 1948 and 1949 were largely responsible for revival of interest in flame cultivation in the Mississippi Delta and other cotton producing areas. An experimental machine, encompassing several radical changes, was tested at the Delta Branch Experiment Station in 1948 in cooperation with The International Harvester Company.[2]

A special feature of this machine was a semi-elliptical, special alloy, cast iron burner, which employed a standard fan-type spray nozzle as an orifice. The burner produced a relatively short, flat flame and was designed to operate at a much greated angle than the conventional round-type burner. When setting the burner at an angle of approximately 45 degrees with the ground, the impact of the flame tended to displace the cool air near the soil so that no convection currents were created. As a result, the flame tended to flatten on the ground with little or no inclination to bounce.

Development of the Flat Type Burner

Further exploration of some of the principles contained in this new experimental flame cultivator, by Delta Branch Experiment Station agricultural enneers, led to other significant developments.[3] These improvements were made after the machine was scrapped and released to the Delta Station by the implement company.

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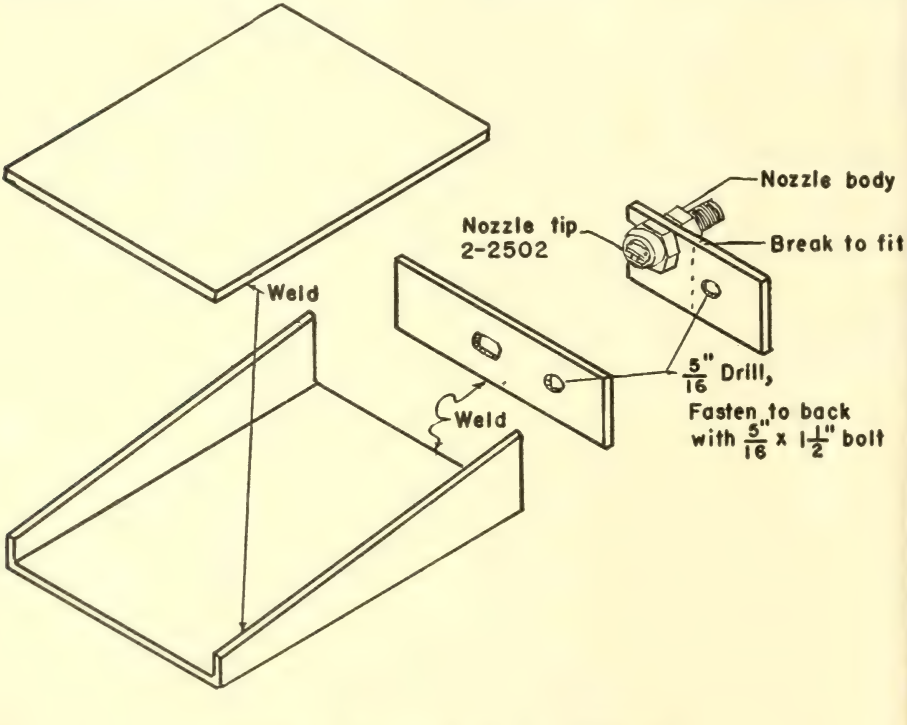
[2] Credit for development of this machine is due Mr. Stewart Pool and Mr. B. J. Shager, International Harvester Company Engineers.

Laboratory tests were first conducted to determine the superiority of the spray nozzle over standard round-type burner orifices. With assistance from the Standard Oil Development Company, flames from the two types of orifices were produced and photographed (see cover). A study of results showed that flame from the regular spray nozzle used in the new burner was short, combustion was excellent, and a good flame pattern was produced. The standard round-type orifice, in comparison, emitted a long thin flame with poor combustion.

Intensive experimentation in burner design subsequently led to the development of a flat, rectangular, sheet metal burner which was equipped with a replacable, fan-type, spray-nozzle orifice (figures 3 and 4). Significant improvements in this burner included (1) low-cost construction, (2) improved flame pattern, (3) greater flame output, (4) accurate and fool-proof adjustment, and (5) adaptability to different machines. The short, flat flame produced by this burner reduced the danger of leaf damage in the cultivated crop, and the use of smaller nozzle orifices permitted earlier



ASSEMBLY OF STONEVILLE BURNER

Figure 3. Exploded view of the flat-type flame cultivator burner.

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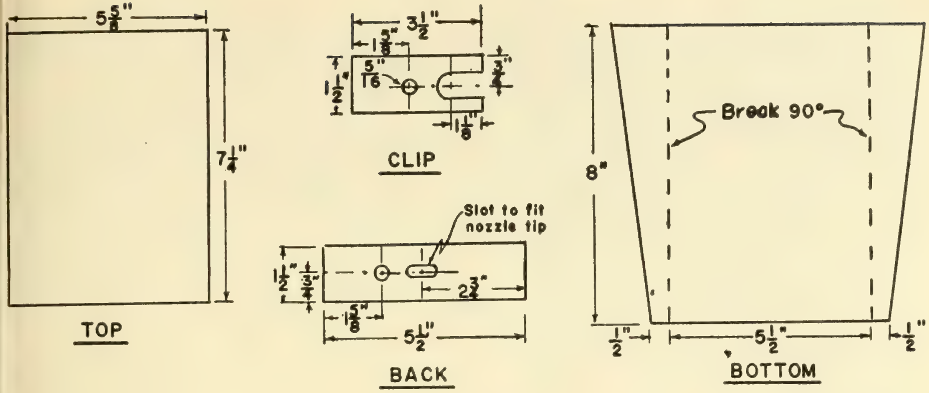
[3] Acknowledgement is hereby accorded Mr. J. K. Jones, Product Development and Service Engineer, John Deere Plow Company, Memphis, Tennessee, for his improvements in flame cultivator equipment. Mr. Jones, formerly Agricultural Engineer at the Delta Branch Experiment Station, Stoneville, Mississippi, was responsible for development of the flat-type burner, which was subsequently adopted by most flame cultivator manufacturers.



NOTE: All parts fabricated from 10 gauge sheet metal

Figure 4. Sheet metal layout of the flat-type burner.

flame application. On the other hand, the wider flame pattern provided a longer exposure period, which allowed a faster rate of travel.

The final shape of this burner was determined by fabricating and testing various pre-production models. Among the critical points in construction was the size of the opening at the burner mouth. It was found that this opening should be exactly one-half inch wide and should be uniform across the burner. Tests showed that variations from this critical dimension adversely affected combustion, uniformity of the flame pattern, length of the cold-air cone in the center of the flame, and the action of the flame when striking the ground.

Further orifice investigations resulted in the development of multiple orifice jets. A twin orifice nozzle, which was developed in cooperation with The Spraying Systems Company, improved burner performance by reducing the length of the flame and smoothing out the flame tips.

Fuel Requirements

Tests were conducted at the Delta Station to compare the capacities of various types of standard burner orifices. As part of the flat-type burner efficiency studies, these tests were replicated and carefully performed under controlled laboratory conditions. Results of a series of fuel consumption determinations with both single- and double-orifice nozzle tips are shown in table 1.

The actual fuel consumption per acre for a specific burner orifice and line pressure may be determined by selecting the proper value under the "Gallons per hour per burner" column in the table. Consumption rates per acre, based on the rate of travel, are shown in the three right hand columns. For example, if orifice tip number 2-2502 was used with a line pressure of 50 p.s.i. and the rate of travel was 3 miles per hour, the amount of fuel consumed per acre would be 4.27 gallons. No allowance has been made for turning time, however. This will vary widely, depending upon the skill of the operator and length of the field.

Field Application Techniques

Careful adjustment of the burners is a primary requirement for maximum flame cultivation efficiency. As shown in figure 5, the flat type burner should be set at an angle of approximately 45 degrees with the ground. The mouth of the burner should be from eight to ten inches away from the drill and from eight to ten inches above the row middles. In this position, the flame should strike the ground two to three inches on the burner side of the drill. The outlet end of the burner should be kept parallel to the row to insure uniform application of the flame. The two burners on each row should be set in tandem so that the flames will not oppose each other. Pressures ranging from 40 to 55 p.s.i. are normally used in the flat-type burner. The higher pressure is used when weed growths are relatively dense.

A study of the actual shape of flame patterns may be made by observing the flame cultivator in the field at night. This should assist in setting the machine properly.

Although recent burner changes and improved application methods have indicated that flaming may be started in some instances when cotton plants are only a few inches tall, initial flame treatments are normally applied with standard size burners when the stalks are approximately 3/16 inch in diameter at the ground level. Since weeds that have reached the same height and toughness

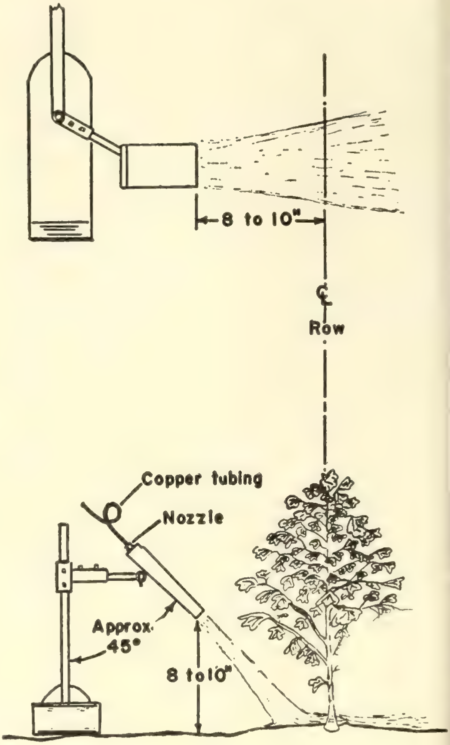


Figure 5. Proper setting for flat type burner

Table 1. Propane capacties of five standard orifice tips used in flat-type cultivator burners.

Orifice tip No.	Line pressure (p.s.i.)	Fuel consumption			
		Gallons per hour per burner	Gallons per acre (2 burners per 40" row)[1]		
			2 mph	3 mph	4 mph
2-2502[2]	30	1.86	4.60	3.07	2.30
	40	2.15	5.32	3.55	2.66
	50	2.59	6.41	4.27	3.20
2-2503[2]	30	2.68	6.63	4.42	3.31
	40	3.11	7.69	5.13	3.85
	50	3.65	9.03	6.02	4.52
4002	20	.75	1.83	1.22	.92
	30	1.20	2.97	1.98	1.48
	40	1.32	3.26	2.18	1.63
4004	20	1.52	3.76	2.51	1.88
	30	2.02	4.99	3.33	2.50
	40	2.25	5.57	3.71	2.78
4006	20	2.19	5.42	3.61	2.71
	30	2.86	7.08	4.72	3.54
	40	2.88	7.13	4.75	3.56

[1] No allowance was made for turning.

[2] Double-orifice nozzle tip.

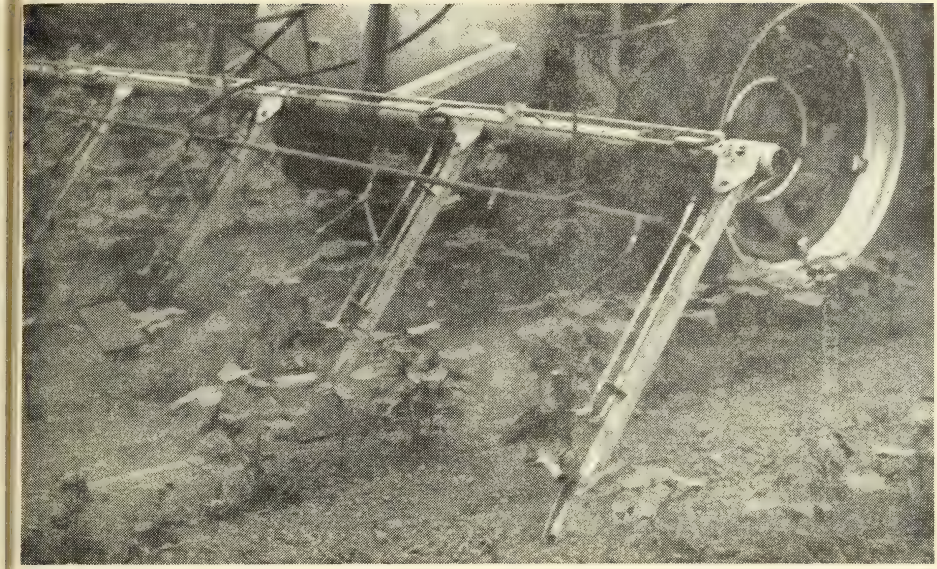


Figure 6. Low uniform beds and properly set burners are essential for maximum flame performance.

as the cultivated crop cannot be controlled satisfactority with flame, early season control measures are usually necessary before flame can be used safely. These may consist of the use of either pre- or post-emergence herbicides, mechanical cultivation, hoeing, or a combination of these treatments. Regardless of the method used, the row profile should be left as smooth as possible to permit maximum efficiency in subsequent flame operations (figure 6).

Timing the flaming treatment is especially important, since the most effective kills are obtained when the weeds are tender and less than 3 inches tall. Frequent flame applications, especially in heavily infested areas, is essential for best results. When it is necessary to remove dense growths of weeds, however, the task should be accomplished through a series of burnings rather than by one or two extremely heavy applications. This will eliminate the danger of damaging grass fires during subsequent flame treatments.

The use of a flame cultivator in conjunction with conventional sweeps has proved to be a good production practice (figure 7). By cultivating the row middles and flaming the drill area simultaneously with one tractor unit, manpower requirements are cut in half, machine operating costs are materially reduced, and excessive machine traffic through the field is eliminated. Savings of this kind are essential in keeping machinery investments at a minimum and in reducing over-all production costs.

Flame cultivation has proved to be an effective tool for controlling most annual and some perennial weeds when properly used. It has not been effective in removing Johnson grass, pig weeds, cockleburs, and perennial vines from row crops, however, except when these plants were in the seedling stage. Best results have been obtained when flame cultivation was combined with other weed control measures, such as chemical weed control, crossplowing, and various other mechanical weed control practices.

Various tests have been conducted to determine the relative efficiency of flame with other methods of weed control. An economic study comparing the efficiency of hand chopping with flame cultivation was conducted on four Delta plantations.

The results, which were published in Mississippi Agricultural Experiment Station Circular No. 143, showed that the average power and labor costs per acre for weed control in cotton were reduced approximately 15 percent by flaming.

A study designed to evaluate several methods of chemical and mechanical weed control was initiated by the Weed Control Project at the Delta Branch Experiment Station in 1950.[4] Under the conditions of this experiment, the most practical and economical method of controlling weeds in cotton with minimum hand labor was three applications of a post-emergence oil followed by five flamings with a pre-emergence herbicide either used or omitted. Tests conducted since 1950 have tended to confirm these results.

Flame cultivation has proved particularly adaptable to late season weed control in cotton, since heavy growths of weeds often occur following late-season rains (figure 8). Effective late-season weed control is an important factor in quality harvesting with mechanical pickers. By equipping the flame cultivator tractor with wheel shields (figure 9), weed control may be continued almost to harvest time.

Cost of Flaming

Fuel is the primary cost in operating a flame cultivator. Since the consumption of L-P gas normally ranges from 4 to 6 gallons per acre, the average cost of fuel is approximately 50 cents per acre. This will normally range from 40 to 70 cents per acre. Based on present machinery, labor and fuel prices, the overall cost of flaming per acre per cultivation ranges from 70 cents to $1.20 per acre. The size of the machine, speed of operation, and the additional operations performed are all factors that determine final costs. The number of flame cultivations required per season for efficient weed control will normally vary from four to six.

Although flame cultivation is not the sole answer in weed control, it has proved economical when wisely used as a part of regular cotton cultural practices.

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[4] Results published in the 1951 Proceedings of the Southern Weed Conference.

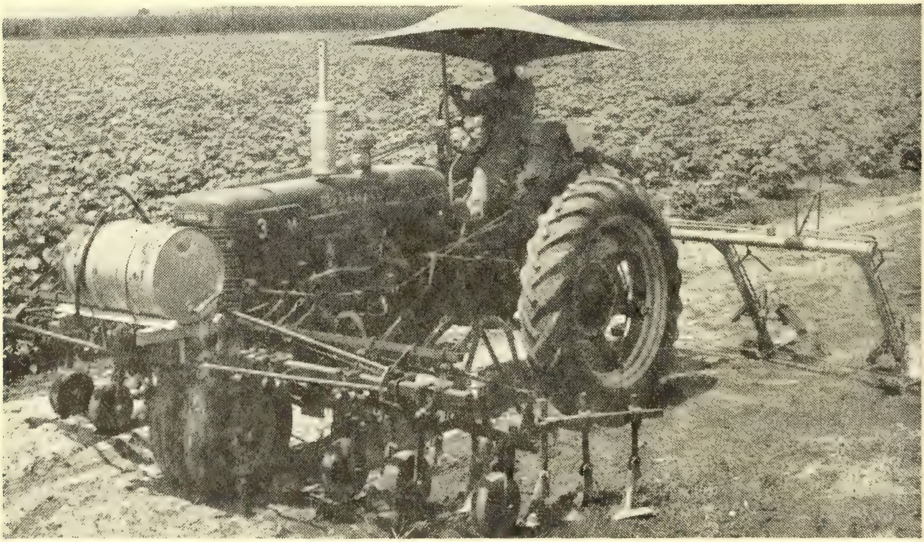

Figure 7. The use of flame cultivation equipment in combination with a standard cultivator reduces the cost of operation.

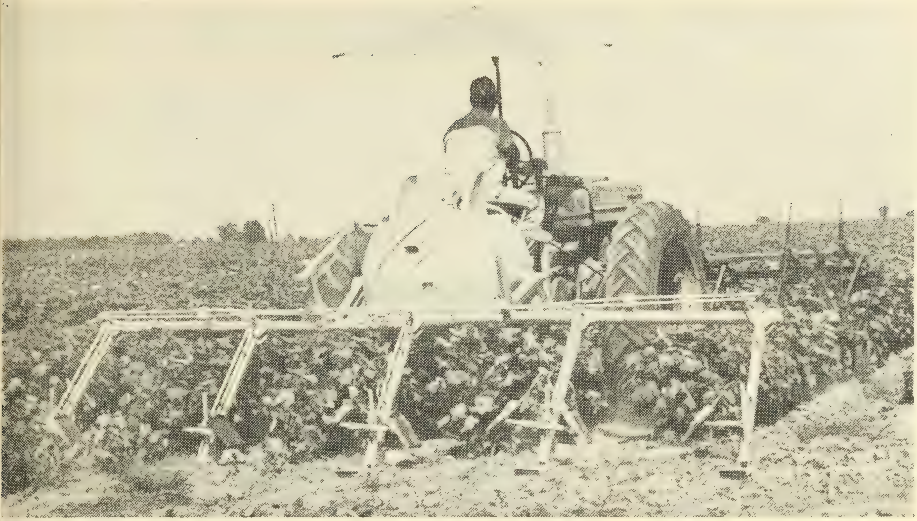

Figure 8. Flame cultivation has proved especially valuable as a late weed control practice in cotton.

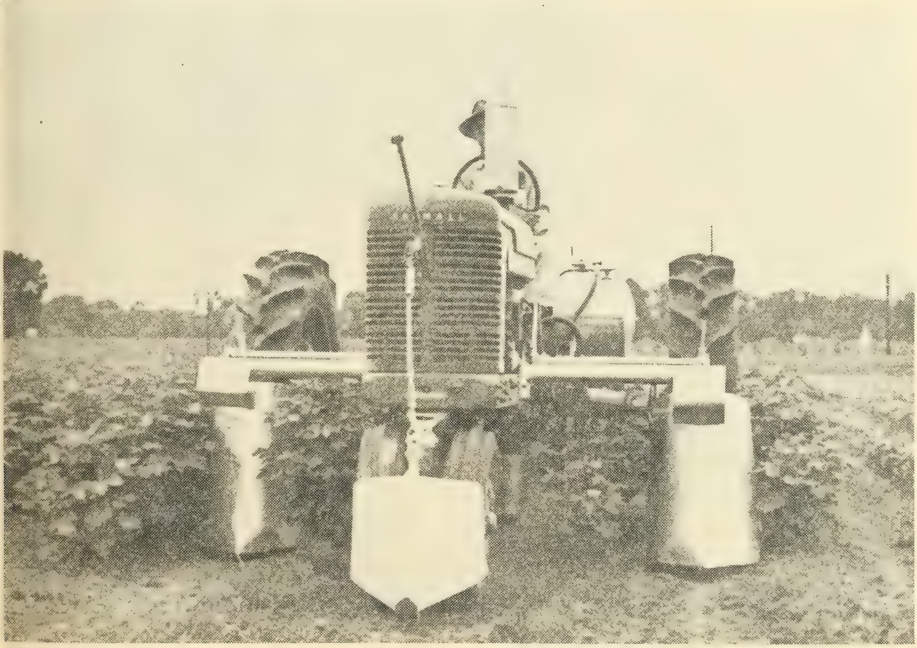

Figure 9. Tractor wheel shields reduce stalk damage when farming late-season or rank cotton.

BULLETIN 546 DECEMBER, 1956

SMALL GRAINS in MISSISSIPPI

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AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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This bulletin has been prepared by members of the Mississippi Agricultural Experiment Station who have been engaged in research on small grains for a number of years.

At State College the work on fertilization was conducted by Roland Cowart; on testing oat varieties for disease resistance and grain yields and on disease investigations by S. S. Ivanoff; on wheat, barley, and rye and forage yields by Darrell Wells; all of State College.

At the Branch Stations the work was done by R. C. Albritton, B. L. Arnold, Clyde Blount, Donald Bowman, Perrin Grissom, Robert Coats, Kelly Freeman, John Gill, B. C. Hurt, Jr., Roy Kuykendall, Russell Landrum, Burke C. Murphy, Louie Walton, and S. L. Wedgworth.

The section on chemical weed control was prepared by W. B. Ennis, Jr., and that on insect control by H. B. Green, both of State College.

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SMALL GRAINS IN MISSISSIPPI

INTRODUCTION

Oats, wheat, barley and rye are mainly used in Mississippi for the production of feed and forage. They provide good pasturage, the length of the grazing time depending principally upon fall growing conditions and winter temperatures. They may be harvested for hay or silage in the spring or as grain and straw. It is less hazardous to produce fall-sown small grain from the standpoint of moisture supply than it is to produce some springs seeded crops because most of the rainfall occurs in the period November through April. Small grains sometimes will fit into a double cropping system with such summer crops as soybeans, sorghum, or millet.

Small grains are widely adapted and may be grown on the fertile well-drained bottom lands, flatwoods soils with good surface drainage, heavy Delta clay soils, sandy land, and the higher lands where summer drouth is a limiting factor in the culture of spring seeded crops. The farm equipment needed to produce small grains can also be used to produce certain summer crops. Cultivation is not required. The peak labor requirement for small grain harvest generally comes after the cotton and corn seeding operations.

FERTILIZATION

For Hill Sections

Recommendations

Forage: Apply 60 pounds of nitrogen, 60 to 120 pounds of phosphate (P_2O_5), 0 to 25 pounds of potash (K_2O) at seeding time about September 1. Topdress in February or March with 60 pounds of nitrogen per acre.

Grain: On fertile soils, do not fertilize in the fall but apply 20 to 40 pounds of nitrogen per acre in February or March; on less productive soils, apply 20 pounds of nitrogen and 20 to 40 pounds of phosphate per acre at time of seeding in October; topdress with 40 pounds of nitrogen in February or March.

How much fertilizer and what kinds should be used for small grain production? The answer to this question depends upon the date of seeding, whether the crop is used for pasture or grain, the native fertility of the soil, and the prevailing weather. Small grain forage is most needed in the fall and winter months when permanent pastures are least productive.

Experiments reported herein show that it is possible to produce 10,000 to 15,000 pounds of green forage per acre by mid-December with adequate moisture and liberal fertilization (60 lbs. N, 120 lbs. P_2O_5, and 0 to 30 lbs. K_2O). However, it has been observed that where planting for forage has been delayed several weeks the lower rate of phosphate (60 lbs. per acre) with 60 pounds of nitrogen per acre will produce as much forage as will the recommended fertilization when seeding is done September 1.

Numerous experiments have shown that for grain production low rates of fertilization in the fall with the recommended application of nitrogen (40 lbs. per acre) as a top dressing in early spring give good results.

For forage production. Until recent years the fertility requirements of small grains had been determined largely for grain production. Experimentation was begun in 1947 to reveal how small grains for forage should be fertilized in Mississippi. In one experiment, four varieties of oats—Camellia, Letoria, Nortex 107, and Victorgrain—were fertilized with 90 pounds of nitrogen alone and with a mixed fertilizer containing 90 pounds of N, 60 pounds of phosphate (P_2O_5), 30 pounds of potash (K_2O), plus a ton of dolomite per acre. Tests were located on two soil types, Prentiss fine sandy loam and

Grenada silt loam. Half of the nitrogen and all of the phosphate and potash were applied at the time of seeding and the other half of the nitrogen was applied as a top dressing at the time of "first clipping" March 15, 1948.

As shown in Table 1, the complete fertilizer produced more forage roughly represented by the "first clipping" than the nitrogen alone at both locations. On the basis of observations there were big differences between the two treatments during the early fall. This difference was much greater on the Grenada soil than on the Prentiss. Since differences of such magnitude as that obtained on the Grenada soil have not been obtained again in seven years, this performance could well be referred to as abnormal. In another experiment conducted on an adjacent area of Grenada silt loam, seedings were made using Clinton, a spring variety of oats. Nitrogen, phosphate, and potash were used separately and together. Only the nitrogen-phosphate combination gave a decided increase in vegetative growth.

To more effectively evaluate the nitrogen-phosphate combination, new experiments were set up at the North Mississippi Branch Station, the Coastal Plain Branch Station, and the Brown Loam Branch Station where different rates of nitrogen and phosphate were used. Summaries of the data collected at the three locations with Delta Red 88 variety of oats are given in Tables 2, 3, 4, and 5, and complete data by years are given in appendix Tables 1, 2, and 3, in the appendix. In the latter tables it may be observed that in the fall of 1948 the most productive fertilization was the 60-120-50 rate which resulted in the production of approximately 1300 pounds of oven-dry oat forage prior to November 1 at Holly Springs and Newton.

At Raymond the yield was 3421 pounds by November 11, or more than 4 times the unfertilized plot yield. This quantity of forage represented enough total digestible nutrients per acre to winter two 1000-pound cows on a maintenance ration from October 15 to March 1. This record was not equaled any other year of the experiment. It may serve as a challenge to make use of supplemental irrigation for early fall grazing if a good supply of water is available. Without satisfactory moisture, high rates of fertilization may result in a heavy financial loss because of inadequate growth before March. After this time, regular pastures are generally in good production.

Data available on the response of wheat to fertilization have shown about the same response as for oats. In Table 6 are total yields of Atlas 66 wheat for the year 1953-54 on a Prentiss fine sandy loam soil. Though early growth was stimulated by the application of a complete fertilizer, the total amount of forage produced was not increased significantly by the application of phosphate or potash fertilizers since most of the growth occurred in the spring. All rates of nitrogen caused some increase in forage yield.

Wheat has been used as the indicator crop in measuring the efficiency of high analysis fertilizer with varying amounts of water soluble phosphorus

Table 1. Forage yields of four varieties of oats fertilized with nitrogen alone and a complete fertilizer* at two locations, 1947-48.

	Pounds of oven dry forage per acre							
	Coastal Plain Branch Station (Prentiss fine sandy loam)				Brown Loam Branch Station (Grenada silt loam)			
	First Clipping		All Clippings		First Clipping		All Clippings	
Variety of oats	90#N	90-60-30	90#N	90-60-30	90#N	90-60-30	90#N	90-60-30
Camellia	653	1010	3872	4326	393	1319	1464	2595
Letoria	623	1059	3999	5191	260	1452	1440	3291
Nortex	635	895	4005	4749	327	1688	1476	3297
Victorgrain	726	1180	3521	4447	363	1779	1579	3412
Average	659	1036	3849	4678	336	1559	1490	3149
L.S.D. between fertilizer treatments:								
.05	69		185		203		352	

*The complete fertilizer carried 90 pounds of nitrogen, 60 pounds P_2O_5, and 30 pounds K_2O per acre. Half of the nitrogen and all the phosphate and potash were applied at the time of seeding, and the other half of the nitrogen top dressed at the time of "first clipping" March 15.

Table 2. Forage yields of Delta Red 88 oats fertilized with different rates of nitrogen, phosphate and potash on Grenada silt loam, North Mississippi Branch Station, 1948-1954.

Nitrogen,* pounds per acre		Pounds of oven dry forage per acre**					
		First Clipping Pounds P_2O_5 per acre			All Clippings Pounds P_2O_5 per acre		
Fall	Spring	0	60	120	0	60	120
0	0	48	93	139	632	674	893
30	30	89	295	432	1691	1934	2024
45	45	97	506	670	2270	2675	2803
60	60	115	652	856	2467	3264	3285
60 + 50# K_2O	60	226	716	867	2618	3288	3460

*Half of the nitrogen and all the phosphate and potash were applied at the time of seeding and the other half of the nitrogen was top dressed in March.

**A 6-year average. The complete data are given in Table 2A in the appendix.

Table 3. Forage yields of Delta Red 88 oats fertilized with different rates of nitrogen, phosphate and potash on Prentiss fine sandy loam, Coastal Plain Pranch Station, 1948-1952.

Nitrogen,* pounds per acre		Pounds of phosphate (P_2O_5) per acre					
		First Clipping			All Clippings		
Fall	Spring	0	60	120	0	60	120
		Pounds of oven dry forage per acre**					
0	0	145	186	230	438	465	531
30	30	281	483	541	1348	1724	1865
45	45	288	665	737	1506	2326	2421
60	60	281	706	885	1777	2592	2803
60 + 50# K_2O	60	337	925	1151	2016	3187	3352

*Half of the nitrogen and all of the P_2O_5 and K_2O were applied at the time of seeding and the other half of the nitrogen was applied in March.

**4-year averages. The complete data by years are given in Table 2A in the appendix.

Table 4. Forage yields of Delta Red oats fertilized with different rates of nitrogen, phosphate and potash on Calloway silt loam, Brown Loam Branch Station, 1948-1953.

Nitrogen,* pounds per acre		Pounds of oven dry forage per acre**					
		Fall or First Clipping Pounds P_2O_5 per acre			All Clippings Pounds P_2O_5 per acre		
Fall	Spring	0	60	120	0	60	120
0	0	307	548	702	1958	2059	2245
30	30	467	877	1142	3150	3528	3521
45	45	519	1083	1348	3362	3988	4352
60	60	569	1137	1379	3920	4475	4840
60 + 50# K_2O	60	562	1263	1559	3771	4734	4970

*Half of the nitrogen and all of the P_2O_5 and K_2O were applied at the time of seeding and the other half of the nitrogen was top-dressed in March.

**5-year averages. The complete data are given in Table 4A in the appendix.

Table 5. Forage yields of Delta Red 88 oats fertilized with different rates of nitrogen, phosphate and potash on Prentiss fine sandy loam, Coastal Plain Branch Station, 1952-54*

Nitrogen** pounds per acre	Pounds of oven dry forage per acre			
	Pounds of phosphate (P_2O_5) per acre			
	0	60	90	120
0	1398	——	——	——
90	3021	2966	3006	——
135	3108	3277	3392	3652
180	3583	3659	3847	3977

Nitrogen and phosphate, pounds per acre	Pounds of oven dry forage per acre		
	Pounds of potash (K_2O) per acre		
	0	30	60
90 N + 90 P_2O_5	3006	3291	3326
135 N + 120 P_2O_5	3652	3975	4087
180 N + 120 P_2O_5	3977	3992	4411

*Yields by years are given in Table 5A in the appendix.

**One-third of the nitrogen and all the phosphate and potash were applied at the time of seeding and two-thirds of the nitrogen top dressed.

in a number of other experiments. The response to fertilizer has been similar to that reported here.

For grain production. In the spring of the year, soil micro-organisms are actively breaking down organic matter into plant nutrients and plants have developed an extensive root system enabling them to make better use of the native soil fertility than was possible in the fall. Because fertility experiments attempt to measure only the deficit between what the plant needs and the capacity of the soil to supply this need, the deficit is not likely to be the same in the fall as in the spring since temperature and moisture conditions are generally so different.

Table 7 shows that the deficit in phosphate and potash between what the soil can supply and what the plant needs is relatively small in the spring in terms of bushels of grain produced. Although there is a difference it is not sufficiently great to be statistically significant with any one of the four varieties of oats used in the experiment.

Over the period 1951 to 1954 more comprehensive experiments were conducted with Delta Red 88 oats at five locations using nitrogen, phosphate, and potash. Data reported in Table 8 show no significant increase in grain yield when phosphate and potash were added but do demonstrate increases for 30 pounds of nitrogen at all locations. Increasing the rate of nitrogen to 45 pounds per acre gave further increases in yield at some locations but not enough to be statistically significant. At the higher rates of nitrogen, more lodging was experienced and more grain lost at harvest. Except for this loss, it is likely that the 45-pound rate of nitrogen would have given significant increases at all locations except on Falkner silt loam at Pontotoc.

Atlas 66 wheat fertilized with nitrogen, phosphate and potash at three locations (see Tables 9 and 10) showed no appreciable increase for phosphate or potash, but a good increase for the 30 pound rate of nitrogen (Table 9). Increasing the rate of nitrogen to 45 pounds did not give further increases

Table 6. Forage yields of Atlas 66 wheat fertilized with different rates of nitrogen, phosphate and potash on Prentiss fine sandy loam, Coastal Plain Branch Station, 1953-54.

Nitrogen* pounds per acre	Pounds of oven dry forage per acre			
	Pounds of phosphate (P_2O_5) per acre			
	0	60	90	120
0	1089	——	——	——
90	2472	2446	2381	——
135	2843	3108	2803	3398
180	3500	3456	3293	3376

Nitrogen and phosphate, pounds per acre	Pounds of oven dry forage per acre		
	Pounds of potash (K_2O) per acre		
	0	30	60
90 N + 90 P_2O_5	2381	2446	2596
135 N + 120 P_2O_5	3398	3369	3413
180 N + 120 P_2O_5	3376	3742	3949

*One-third of the nitrogen and all the phosphate and potash were applied at the time of seeding and the remaining nitrogen was top dressed.

Table 7. Grain yields of four varieties of oats fertilized with nitrogen alone and a complete fertilizer at two locations, 1948.

Variety of oats	Bushels per acre			
	Coastal Plain Branch Station		Brown Loam Branch Station	
	45 lbs. N*	45-60-30** 2000 lbs. dolomite	45 lbs. N*	45-60-30** 2000 lbs. dolomite
Camellia	58.6	62.3	42.8	50.0
Letoria	69.7	71.7	48.2	57.8
Nortex	64.9	69.5	54.5	60.4
Victorgrain	60.8	68.1	45.4	56.0
Average	63.5	63.0	47.7	56.0
Increase	—	4.5	—	8.3

*N = Pounds of nitrogen applied per acre.

**Mixed fertilizer carrying 45 pounds of nitrogen, 60 pounds P_2O_5 and 30 pounds of K_2O per acre.

45
36
270
135

1620
20
32400

Table 8. Grain yields of Delta Red 88 oats unclipped fertilized with different rates of nitrogen, phosphate and potash at five locations, 1951-1954.

Pounds per acre N P_2O_5 K_2O	Bushels per acre Holly Springs Grenada silt loam 1951-53	Raymond Calloway silt loam 1950-54	Newton Prentiss fine sandy loam 1951-52	Brooksville Houston clay 1949-53-54	Pontotoc Falkner silt loam 1952-54
0-0-0	14.1	30.5	17.2	30.5	24.1
0-60-0	16.0	28.8	13.5	32.9	22.6
0-120-0	16.7	26.4	18.4	32.8	22.7
30-0-0	42.3	43.6	33.9	35.3	39.7
30-60-0	49.2	44.4	41.1	56.8	39.0
30-120-0	47.5	45.1	38.8	55.8	39.1
45-0-0	51.5	43.0	32.3	54.2	39.6
45-60-0	51.9	48.1	38.0	57.4	40.1
45-120-0	57.0	49.5	31.7	60.1	41.3
60-0-0	54.2	45.1	30.7	58.8	43.0
60-60-0	58.2	48.2	38.6	61.4	41.5
60-120-0	59.9	51.5	34.0	58.2	41.5
60-0-50	53.1	43.3	38.9	58.3	41.8
60-60-50	55.1	50.1	45.9	60.4	45.6
60-120-50	62.2	51.9	48.2	59.8	43.6

Table 9. Grain yield of Atlas 66 wheat fertilized with different rates of nitrogen, phosphate and potash on two soil types, 1953-1954.

Pounds per acre	Spring Nitrogen only	Bushels per acre					
		Pontotoc			Brooksville		
Fall		Falkner silt loam			Houston clay		
N P_2O_5 K_2O		1953	1954	Ave.	1953	1954	Ave.
0-0-30	0	13.3	10.2	11.7	18.7	13.2	15.9
0-60-30	0	12.7	11.1	11.9	19.5	13.6	16.5
0-120-30	0	12.6	10.1	11.4	20.6	14.7	17.6
30-0-30	30	14.7	16.0	15.2	32.6	32.8	32.7
30-60-30	30	17.8	15.9	16.9	36.7	32.0	34.3
30-120-30	30	16.6	16.1	16.4	34.2	33.3	33.7
45-0-30	45	15.5	17.4	16.5	38.9	41.0	39.9
45-60-30	45	19.8	17.7	18.8	39.5	41.3	40.4
45-120-30	45	16.3	17.4	16.9	40.8	40.5	40.6
60-0-30	60	18.9	17.5	18.2	39.0	37.2	38.1
60-60-30	60	18.8	17.2	18.0	42.9	40.0	41.4
60-120-30	60	17.9	17.5	17.7	42.6	39.6	41.1
60-60-0	60	18.5	16.5	17.5	41.1	37.9	39.5
60-120-0	60	19.5	16.7	18.1	40.6	36.7	38.6
60-60-60	60	17.3	16.9	17.1	41.2	40.2	40.5
60-120-60	60	—	—	—	40.9	40.8	—

except on Houston clay soil at Brooksville (Table 9). Wheat, like oats, lodged more at the higher rates of fertilization. With better harvesting facilities and varieties more resistant to lodging, the use of rates of nitrogen higher than 45 pounds should be practical.

For Delta Section

Nitrogen is the only plant nutrient which is generally deficient for small grain production on Delta soils. Sources, rates, and time of application of nitrogen are the main considerations involved in a small grain fertility program for the Delta.

The small grain fertilizer studies on Delta soils have largely been restricted to grain production with oats. A number of field trials and field observations have suggested that the results obtained with oats are applicable to wheat and barley.

The results of a 28-year test of kinds of fertilizer are shown in Table 11. These tests were conducted on a well drained sandy loam soil and a cotton-oats-corn cropping sequence was followed. All materials were applied at the rate of 30 pounds of nitrogen per acre prior to 1952 and at the rate of 45 pounds since then. The date of application varied from March 5 to March 19. Nitrate of soda produced the highest yields although the differences among nitrate of soda, ammonium nitrate, and ammonium sulphate were small. Cyanamid was toxic to the oats for a few days following its application and was not therefore satisfactory as a top-dressing. Cottonseed meal also failed to produced satisfactory yields.

Two tests of rates of nitrogen application using nitrate of soda were conducted under conditions similar to the sources tests described above. The 28-year results of one of these are listed in Table 12. The yields increased as the rate of nitrogen application increased.

In the fall of 1950 another nitrogen rates test (Table 13) was begun to study the effect of higher rates on oat grain yields. Yields increased as the rate of nitrogen increased up to 75 pounds per acre. Lodging was a problem and varied with the season and with the rates. In most cases severe lodging occurred when the rate of nitrogen exceeded 75 pounds per acre.

In applying the results of these tests to field conditions it should be pointed out that these tests were conducted under conditions where carry-over nitrogen was not an important factor. In recent years, oats following highly fertilized cotton have shown the effect of considerable nitrogen carry-over. Where this is true adjustments must be made in the rate of application to compensate for the carry-over.

No tests have been conducted in recent years measuring the effect of time of application of nitrogen on grain yields. Earlier test results showed that maximum yields were obtained from top-dressing between March 1 and March 15. Field observations in recent years have not indicated any variation from earlier results.

WINTER HARDINESS

The small grains exhibit a wide range of cold tolerance. Rye and wheat

Table 11. The influence of sources of nitrogen on the yield of oats, Delta Branch Experiment Station, 1928-1953.

Source of Nitrogen	28-year average in bushels per acre
No nitrogen	18.5
Nitrate of soda	55.8
Ammonium nitrate	53.7
Ammonium sulphate	50.8
Cyanamid	42.9
Cottonseed meal	32.0

Table 10. Grain yields of Delta Red 88 oats and Atlas 66 wheat fertilized with different rates of nitrogen, phosphate and potash on Calloway silt loam, with and without clipping, to simulate grazing and no grazing, Brown Loam Branch Station, 1951-1954.

Fertilizer treatment Pounds per acre		Bushels of grain per acre					
		Oats				Wheat	
		1951		1954		1954	
Fall N P2O5 K2O	Spring Nitrogen only	Clipped March 22	Un clipped	Clipped March 4	Un-clipped	Clipped March 4	Un-clipped
0-0-30	0	8.0	13.3	39.7	41.0	20.5	23.9
0-60-30	0	7.3	20.0	36.5	39.3	19.4	23.3
0-120-30	0	9.8	18.3	36.1	40.6	18.2	22.3
30-0-30	30	14.4	32.7	53.8	56.3	26.9	32.7
30-60-30	30	17.4	38.6	56.4	59.6	27.5	34.4
30-120-30	30	17.4	43.3	52.0	57.4	24.6	33.5
45-0-30	45	14.8	31.6	51.5	53.0	26.9	29.1
45-60-30	45	17.2	42.4	57.9	60.1	27.7	31.0
45-120-30	45	20.0	52.1	55.3	57.9	25.6	29.6
60-0-30	60	22.5	38.8	50.8	51.0	27.9	29.0
60-60-30	60	26.0	54.0	49.1	50.2	26.7	28.7
60-120-30	60	24.7	59.9	49.8	50.7	26.7	27.3
60-60-0	60	25.2	51.6	51.3	50.1	25.9	29.2
60-120-0	60	23.8	57.2	50.9	49.5	26.4	28.8
60-60-60	60	23.6	63.2	49.1	49.7	26.3	29.6
60-120-60	60	24.6	65.2	49.0	50.4	26.8	30.6
Average		18.5	48.7	49.3	51.0	25.2	28.9
Reduction, %		62*		3.3		12.8	

*The rainfall was less than half inch from April 22 to June 1, which prevented a normal recovery after clipping and fertilizing.

are hardiest, followed by barley and oats. Among all four crops are varieties sufficiently hardy for safe use in Mississippi although each crop contains relatively non-hardy varieties.

Freezing temperatures may affect small grains in a number of ways. The most important cold damage in Mississippi is the destruction by frost of the green forage in winter, when grazing is most needed. Grain yields at times are significantly reduced by heaving, foliage destruction and frost damage to flower parts.

Table 12. The influence of rates of nitrogen on the yield of oats, Delta Branch Experiment Station, 1928-1955.

Pounds of nitrogen per acre	28-year average in bushels per acre
0	17.7
7.5	27.4
15	37.3
22.5	45.4
30	51.5
37.5	55.3
45	57.7

The extent and kind of cold injury depends not only upon how low the temperature goes but also on the amount of growth which is determined by age and soil fertility, whether the plants have reached the jointing or heading stage, whether the small grain has been grazed or not, and the lay of the land where the grain is growing. An abrupt change in temperature is more damaging than slow gradual change.

Infrequently, frost injury occurs in the spring at heading time. In Mississippi, wheat and barley have been more often affected than rye and oats. The essential flower parts and the developing seeds are affected so that at maturity many heads have nothing but shriveled seed in them or no seeds at

Table 13. The influence of rates of nitrogen application on the yield of oats, Delta Branch Experiment Station, 1951-1955.

Pounds of nitrogen per acre	Annual yield of oats in bushels per acre					
	1951	1952	1953	1954	1955	Average
0	23.6	22.9	15.1	10.3	8.3	16.0
45	54.2	60.1	66.4	72.5	39.3	58.5
60	65.0	67.9	72.9	79.4	42.6	65.6
75	71.8	73.6	79.0	88.6	42.8	71.2
90	74.8	79.8	88.2	79.0	45.4	73.4
105	76.5	75.1	91.6	74.6	45.7	72.7
120	81.3	72.4	88.1	71.1	45.2	71.6

Oat varieties differ greatly in degree of winterhardiness. The left three rows were little affected by freezing. The right three rows of another variety were killed by frost.

all. Partially or full exposed heads are more easily injured than heads still in the boot. Low lying fields with little or no air drainage are most likely to be affected.

RATE OF SEEDING

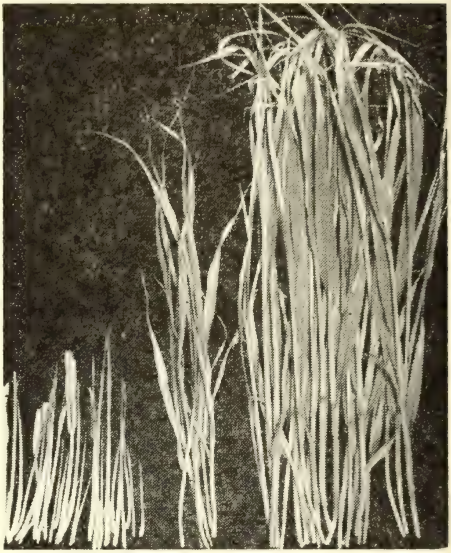
The common rate of seeding of small grains is about 75 pound per acre for grain production and 90 to 100 pounds for forage production though research has shown that a wide range of seeding rates will usually give similar results. It is only when seedbed conditions are especially hazardous or late seeding is being done that the recommended rates or even higher rates are really necessary to obtain a suitable stand and a sufficiently high number of tillers per square foot. An adequate stand may usually be obtained from 40 to 60 pounds of grain per acre. Seedbed and weather conditions, not rate of seeding, are therefore the important factors in getting a good stand.

High rates of seeding may be responsible for lodging. A few plants of many tillers each will stand and yield better than many plants of few tillers each on the same area of soil.

Seeding rates of 6 to 14 pecks per acre for oats were studied at the Delta Experiment Station. Results are shown in Table 14. Seeding was done at or near October 15.

The average yields for the ten-year period are nearly the same, suggesting the suitability of a rate between 6 and 8 pecks per acre.

At State College in a one-year test of seeding rates, normal yields were obtained of Mustang oats and Kenbar barley throughout the range of 20 to 120 pounds for the oat and 27 to 162 pounds for the barley.



A plant sample taken from an oat field near Brooksville April 7, 1955 showing 27 small new tillers at the left, six surviving tillers in the middle, and at the right 31 main tillers (not all shown) in which the heads and stems were killed by frost March 26 and 27, but on which leaves are still green.

DATES OF SEEDING

Annual and average yields in tests at the Delta Branch Station are shown in Table 15. Rate of seeding was 10 pecks per acre. The highest average yield of 63.4 bushels was obtained from the October 15 seeding. Average yields of 58.8 bushels per acre were harvested from the October 1 and November 1 seedings. Mid-October seedings were generally the most satisfactory though normal yields were usually obtained from seedings made September 15 through November 15. February and March seedings resulted in satisfactory yields in only one year, 1931.

Table 14. Yields of grain per acre from seven rates of seeding of Ferguson 922 and Delta Red 88 oats at the Delta Branch Experiment Station 1929 through 1939.

Seeding rate in pecks per acre	Annual and average yields in bushels										10-year average
	1929	1930	1931	1932	1933	1934	1935	1937	1938	1939	
6	64.6	61.8	92.8	49.5	49.9	77.4	35.3	62.9	73.2	78.3	64.6
8	49.4	59.3	94.3	51.7	50.0	73.9	32.6	63.0	74.0	79.5	62.8
9	74.0	59.4	90.8	50.1	54.3	81.2	42.0	58.2	72.2	78.3	66.5
10	72.3	57.5	95.3	48.5	52.7	73.9	39.4	61.3	72.5	79.3	65.3
11	69.6	58.1	91.0	49.6	49.6	88.3	43.8	58.1	71.4	78.5	65.8
12	73.4	56.3	93.4	52.5	48.1	71.9	44.9	60.6	69.8	76.8	64.8
14	67.9	57.8	104.3	48.5	51.0	63.4	38.2	52.3	73.3	77.9	63.5

Table 15. Yields of grain from Ferguson 922 and Delta Red 88 oats seeded at different dates, September 15 to April 1 at the Delta Branch Experiment Station, 1931 through 1939.

Dates of seeding	Annual and average yields per acre									9-year average
	1931	1932	1933	1934	1935	1936	1937	1938	1939	
September 15	84.4	40.2	33.7	64.5	26.9	50.1	56.6	64.7	81.7	55.9
October 1	84.0	39.9	57.9	55.9	31.1	45.9	64.9	64.9	82.7	58.8
October 15	71.7	37.4	79.6	56.2	33.8	51.1	72.2	80.8	87.7	63.4
November 1	79.7	44.4	78.1	56.6	24.4	24.7	63.7	80.4	76.9	58.8
November 15	89.3	38.0	63.0	61.3	9.6	24.4	62.6	59.6	80.5	54.2
February 15	63.7	.0	4.6	21.2	.0	23.0	6.7	13.3	11.1	16.0
March 1	67.4	.0	.2	19.9	.0	23.5	2.0	9.3	11.5	14.9
March 15	47.2	.0	.7	14.9	.0	10.3	1.3	.0	10.5	9.4
April 1	.0	.0	.0	.0	.0	3.2	.0	.0	2.8	.7

For grain production in the central portion of Mississippi it is recommended then that small grains be seeded for grain production in mid-October. In South Mississippi seedings are sometimes delayed a week or two and in North Mississippi are advanced from one to two weeks for best results. Late winter or spring seeding of small grains is not recommended.

For forage production. Small grain pastures should be seeded about three to four weeks earlier than the dates recommended for grain production alone.

At times worms may damage early seedings, especially in South Mississippi. August 15 seedings have been unsuccessful for forage in two years of the testing at State College because of intense heat and drouth. Although these August seedings produced stands only ten percent of normal they gave yields of grain nearly as good as is normally expected because the plants tillered profusely. Successful August seedings may most likely be made by deep drilling of the seed on fallowed land.

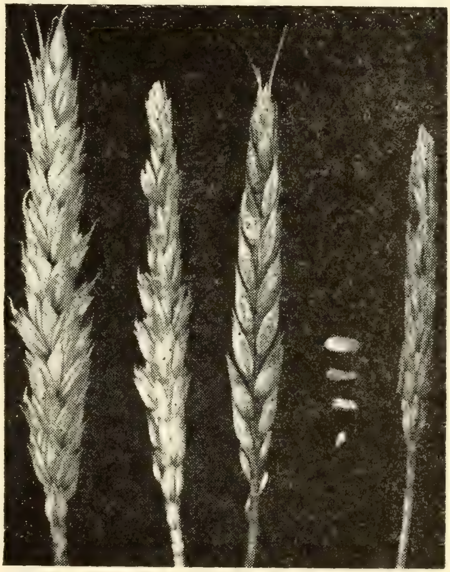
Late seedings produce less early forage. Grain yields after grazing, however, will be little affected by a wide range of dates of seeding. Maturity dates will vary only slightly except when seeding has been done later than in December.

GRAIN YIELDS

Oat, wheat, and barley variety tests have been carried on for many years in Mississippi. Rye tests were begun more recently. The usual procedure in testing varieties has been to seed each entry in three to five rows one foot apart and eight to twenty feet long. Each test has been seeded three to six times at each location, in order to obtain a more dependable average yield for each entry.

Some of the oat, wheat, and barley tests have been conducted cooperatively with the Bureau of Plant Industry and with other Southeastern states. In these uniform tests, new strains are compared with standard varieties. Other tests have been made of many strains bred or selected in Mississippi in comparison with commercial varieties.

These tests have been seeded by hand or with modified garden drills. The plots were harvested by hand and



Mature heads of Chancellor wheat showing the effects of frost injury in 1953 on the flowers at heading time. A normal head is shown at the left. The two center heads, one with outer chaff removed, each contain several normal seeds. Four seeds affected by frost are shown. The head on the right is completely sterile.

the grain threshed in small stationary or portable nursery threshers. Threshed samples were cleaned if necessary, weighed, and test weights per bushel obtained when sufficient grain was available.

Grain yield tests reported here have been conducted at State College and at most Branch Stations.

Oats

In choosing a variety, yield is usually considered first. Disease resistance, lodging resistance and winterhardiness contribute to yield. Earliness and grain quality are also important.

Oat varieties grown in Mississippi may be divided into four groups:

1. **The Red "Rustproof" (Texas Red) Oats.** These varieties are some of the oldest in Mississippi. They were introduced from Southern Europe and North Africa and were found by the early settlers to be better adapted in the South than other oats. They soon were known as "Texas Red" because most of the seed was then grown in Texas where large acreages and early introduction of machine harvesting made that state the chief source of seed in the South. The name "Rustproof" was applied to them because they did not rust as much as oats from the North. Since then, however, new strains have appeared of the rust parasite to which these oats are not resistant. Consequently, the name "Rust proof" is misleading.

Many selections have been made from the Texas Red oats through the years by various growers, seed companies and experiment stations, each selection appearing under a new variety name. Following is a list of Red "Rustproof" and related oats: Alabama Red, Alber, Appler, Baylis, Delta Red 88, Ferguson 922, Hundred Bushel, Madison County Red, Nortex, New Nortex, Nortex 107 and Tifton 14.

Baylis, Delta Red 88, Madison County Red and Nortex 107 have originated in Mississippi.

Except for minor differences in rate of growth and cold tolerance noticeable at early stages of growth, the 12 varieties are very similar. The kernel characters are identical and the yields of forage and grain are about the same. The chief justification for having so many names for practically the same oat has been the higher degree of uniformity and purity that some originators wished to have for their selections.

As a group these oats are moderate to good in production. Under favorable conditions and with proper management they have given high yields. They have good root systems and resist Victoria blight. They are mid-season to late in maturity and semi-winterhardy, though at times frost damages the foliage. Their straw is weak and lodging is common, especially at higher rates of fertilization.

2. **The Victoria derived oats.** Included here are some of the highest yielding varieties of oats. They are of recent origin and were developed chiefly for resistance to leaf rust by hybridizing local varieties with Victoria, a rust resistant introduction from South America. To this group belong Alamo, Arlington, Atlantic, DeSoto, Fulgrain, Letoria, Mustang, Stanton, Traveler, the Victorgrain strains, and others. As a rule these varieties show high resistance to leaf rust although the rust parasite does produce burned spots on the leaves.* When numerous, these spots damage the plants considerably. This group of oats is completely susceptible to Victoria blight, a disease not recognized until these oats had been put into production.

Mid-South is a new oat which is being released by the Mississippi Agricultural Experiment Station to certified growers in 1957. It is a Victoria-blight resistant selection from Victorgrain 48-93.

3. **The Bond derived oats.** These varieties were obtained from crosses between native oats and the Australian variety Bond. Among them are Camellia and Delair which combine high yielding ability with resistance to leaf rust and to Victoria blight. New rust parasites capable of infecting these va-

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*This spot effect is known as the "Victoria reaction."

rieties have appeared and lessened their usefulness. They are grown profitably, however, in some localities in Mississippi because of other good qualities. Camellia is a good forage producer and medium late but lodges badly at maturity. In some seasons it has rusted considerably.

Delair is a high yielding oat in the absence of leaf rust to which it is susceptible. Because Delair resists Victoria blight and is early and has stiff straw, it is grown extensively in the Delta.

4. **The Tennessee Winterhardy oats.** North Mississippi farmers sometimes use Forkedeer, Fulwin and Tennex which grow slowly, stool heavily, and are seldom damaged by cold in Mississippi. They attract attention after a severe winter when other oats have been badly damaged. These oats have weak straw and are very susceptible to leaf rust. They are not adapted to Central and South Mississippi. Le Conte, a new addition to the above group, has stiffer straw making it better adapted for combine harvesting.

Varieties Recommended for Mississippi.

(1) The red "rustproof" oats, (Delta Red 88, Nortex 107, Madison County Red, Ferguson 922) are recommended for the entire state because of their adaptability and moderate to good yielding capacities.

(2) For the north and central parts of the hill section Mustang, Arlington, Victorgrain 48-93, and Fulgrain are recommended, this being the order of their frost resistance. Because they are subject to Victoria blight, these oats should be grown when possible in crop rotations in which oats are planted only every third or fourth year.

(3) For South Mississippi, Camellia and Alber are recommended in addition to the red "rustproof" varieties. Alamo may be included if grown in rotation.

(4) For the Delta the same varieties as for North and Central Mississippi are recommended, with the addition of Delair.

Holly Springs: Oats grown in North Mississippi whether for grazing or grain should be coldhardy. In the grain yield trials at Holly Springs, 1950-1954, the best yielding varieties on the whole have been those with the greatest winterhardiness. Arlington, Victorgrain 48-93, and Mustang, have given the highest yields followed by Red oat varieties. (Table 16).

Camellia was least hardy of the varieties tested and is not recommended. Because Delair is the earliest oat it has been subject to bird damage, reducing the yields some years.

All of the varieties tested, except Camellia, were satisfactory and in normal seasons produced good grain crops. Forkedeer, Le Conte and Arkwin, oats from Tennessee and Arkansas, recently have been included in the tests because of their greater winterhardiness. They have not been tested long enough to establishd grain production records. They are susceptible to leaf rust.

Stoneville: The average acre yields since 1948 of 15 oat varieties grown at the Delta Branch Experiment Station are shown in Table 17. Their characteristics are shown in Table 18.

Table 16. Oats, grain yields, Holly Springs, 1950-1954.

Variety	1950	1951	1952	1953	1954	5-Yr. Av.
			Bushels per acre			
Arlington	50.0	36.1	42.2	55.1	104.3	57.5
Camellia	54.0	9.4	30.1	41.6	67.7	40.6
Delair	55.0	29.4	38.1	30.8	53.3	41.3
Delta Red 88	57.0	27.0	34.9	61.9	90.8	54.3
Fulgrain	55.0	30.3	44.0	44.5	76.5	50.1
Madison County Red	36.0	36.2	44.9	66.6	—	—
Mustang	48.0	40.6	51.3	52.8	90.8	56.7
Nortex 107	49.0	34.8	36.3	60.4	88.2	53.7
Victorgrain 48-93	61.0	42.0	42.2	49.2	90.4	57.0
Arkwin	—	—	—	41.6	71.7	—
Forkedeer	—	—	—	57.4	66.1	—
Le Conte	—	—	—	52.6	72.0	—

Table 17. Oats, grain yields at the Delta Branch Experiment Station, Stoneville, 1948-54.

Variety	Bushels per acre							Average yield	Percent of Delta Red 88
	1948	1949	1950	1951	1952	1953	1954		
Delta Red 88	66.0	61.8	60.6	85.7	87.9	81.1	49.2	70.3	100
Nortex 107	73.4	56.5	67.6	84.7	91.4	73.9	37.5	69.3	98
Alber	67.7	59.1	56.6	81.6	97.1	85.8	55.3	71.9	102
Delair*	49.1	71.7	44.9	74.5	86.3	66.4	38.4	61.6	88
Fulgrain	57.1	70.7	60.5	71.1	93.2	82.2	32.2	66.7	95
Camellia	48.7	35.9	44.3	79.6	79.0	63.8	17.9	52.8	75
Victorgrain 48-93	59.5	88.5	79.1	88.1	108.9	95.2	61.8	83.1	118
Arlington	77.5	69.4	64.4	73.0	114.0	89.1	40.8	75.4	107
Mustang	64.3	56.2	63.5	73.5	88.2	87.3	38.5	67.4	96
DeSoto	65.5	63.6	54.5	90.7	79.4	60.6	31.3	63.7	90
Madison County Red	59.9	54.1	62.3	77.8	90.8	77.4	—	66.6	95
Stanton 1	63.8	59.0	68.3	69.4	89.2	68.7	—	65.8	94
Letoria	60.0	64.0	50.3	83.6	58.7	70.6	—	60.7	87
Alamo	—	—	61.3	92.0	90.0	73.0	47.8	70.3	100
Southland	—	—	73.1	66.8	89.0	78.7	—	67.9	98

*Delair is generally the earliest maturing variety in the test. Its yield is frequently reduced as a result of disproportionate bird feeding.

Table 18. Characteristics of 15 oat varieties grown at the Delta Branch Experiment Station, Stoneville, Miss., 1948-1954.

Variety	Test weight lbs. per bushel	Date headed ripe		Percent lodged	Plant height inches	Growth habit
		April	May			
Delta Red 88	31	27	27	53	48	P
Nortex 107	30	28	26	56	46	P
Alber	31	24	26	50	47	P
Delair	36	12	15	57	49	U
Fulgrain	35	17	17	57	44	U
Camellia	30	28	27	66	49	Int.
Victorgrain 48-93	34	22	21	56	49	Int.
Arlington	32	24	23	55	50	Int.
Mustang	32	24	24	47	46	P
DeSoto	32	27	27	56	44	Int.
Madison County Red	32	28	25	52	47	P
Stanton I	34	23	23	43	47	Int.
Letoria	33	27	26	36	47	P
Alamo	34	18	22	52	45	U
Southland	32	27	27	56	44	Int.

Abbreviations: P—Prostrate; U—Upright; Int.—Intermediate.

The system of farming employed on many Delta farms requires an oat variety sufficiently early to be followed by a soybean or summer feed crop. To permit this practice it is important that the oat crop be ready to combine about May 20.

The recommended varieties for the Delta fall into the three groups—early, mid-season and late. Delair and Fulgrain are the earliest adapted varieties, maturing about May 15 to 20. Delair is generally 2 to 3 days earlier than Fulgrain. Both varieties produce a good yield of high test weight grain.

Victorgrain 48-93, Alamo, Arlington, and Mustang are the recommended mid-season varieties. They are generally ready to combine about the last week of May.

The late group includes Delta Red 88, Nortex 107, Madison County Red and Ferguson 922. They generally mature about June 15. The group is characterized by a slower, prostrate type of growth during the winter months, by weak straw which makes them more likely to lodge, and low test weight.

Newton: Mustang and Arlington have been productive because of their hardiness. Victorgrain 48-93, Fulgrain, Mustang, Arlington and Delta Red 88 have performed well. Alber and Camellia have given moderate to good yields, but Camellia has lodged badly. Victorgrain 48-93 outyielded all other varieties in the 1950-1954 period. Its yields have sometimes been greatly reduced in some commercial fields by Victoria blight and similar diseases.

Yields are presented in Table 19.

Raymond: Among the oat varieties tested for a five-year period, Victorgrain 48-93 led with 60.5 bushels per acre, followed by Mustang, Madison County Red and Fulgrain. The variety planted by most farmers in the Brown

Loam area is Delta Red 88 which produced an average of 48.0 bushels of grain per acre in the yield tests.

An early maturing oat variety can sometimes be followed by sorghum or soybeans. Delair, Fulgrain and Victorgrain 48-93 are from one to two weeks earlier in maturity than the other varieties. Delair has been the most resistant to lodging of the three.

Table 20 shows the grain yields in detail.

McNeil: Grain production of oats in South Mississippi has been uncertain because of damage by leaf rust, Victoria blight, spring storms and frost. For winter grazing however, oat crops have been quite successful.

New varieties are needed which combine high resistance to rust and to Victoria blight with stiff straw. Until such new varieties are developed, the Red "Rustproof" oats and Fulgrain, Victorgrain 48-93, and Camellia will remain the best varieties for this area.

Yields are shown in Table 21.

State College, 1949-1954: The five-year average yields at State College follow closely the general pattern of results for the entire state. Fulgrain and Victorgrain 48-93 led with nearly 57 bushels per acre, about five bushels ahead of the next best yielder, Delta Red 88 (Table 22).

Summary for State

Of the ten commercial varieties grown for grain in Mississippi, Victor-

Table 19. Oats, grain yields at Newton, 1950-1954.

Variety	1950	1951	1952	1953	1954	5-year average
	Bushels per acre					
Alber	38.3	59.0	81.7	36.3	47.0	52.5
Delta Red 88	44.5	37.0	88.7	43.5	53.8	55.0
Victorgrain 48-93	24.7	71.0	79.8	47.0	51.1	61.7
Nortex 107	41.7	52.0	68.7	40.5	43.2	53.4
Camellia	41.1	65.0	45.7	35.2	46.5	45.7
Fulgrain	15.9	62.0	91.5	27.4	54.0	57.7
Mustang	40.6	54.3	69.2	58.8	56.4	55.8
Arlington	42.4	54.3	63.6	64.4	50.9	55.1
Delair	26.6	48.8	63.1	39.5	63.8	48.3
Bonda	38.0	27.0	52.5	48.5	52.5	43.7

Table 20. Oats, Grain Yields at Raymond, 1950-1954.

Variety	1950	1951	1952	1953	1954	5-year average
	Bushels per acre					
Alber	36.0	49.1	47.8	49.9	33.5	43.3
Arlington	39.0	69.3	49.9	58.0	41.3	51.5
Bonda	27.0	35.5	59.8	34.0	55.5	42.4
Camellia	36.0	24.7	41.6	47.7	40.4	38.0
Delair	16.0	20.2	88.0	38.5	36.9	39.9
Delta Red 88	34.0	59.4	47.8	56.4	41.3	48.0
Fulgrain	34.0	38.8	77.1	70.0	44.7	52.9
Madison County	54.0	61.9	56.1	47.0	—	54.7*
Mustang	62.0	53.6	58.1	57.6	41.7	54.6
Nortex 107	41.0	62.7	50.6	54.0	40.7	49.8
Victorgrain 48-93	42.0	53.2	77.7	69.0	50.6	60.5

*Four year average.

Table 21. Oats, grain yields at McNeil, 1948-1954.*

Variety	1948	1949	1951	1952	1954	5-year average
	Bushels per acre					
Alamo	—	—	—	—	74.0	—
Alber	30.4	5.2	9.3	60.3	41.3	29.3
Arlington	—	—	—	45.0	23.6	—
Bonda	0.7	0.0	0.0	36.6	38.0	15.1
Camellia	18.6	6.6	3.8	56.6	38.1	24.7
Delair	—	0.0	3.1	51.3	67.6	—
Delta Red 88	24.2	1.4	5.9	61.6	45.6	27.7
DeSoto	—	—	—	—	41.0	—
Fulgrain	12.8	3.4	6.0	83.7	74.5	36.1
Madison County Red	21.9	2.4	5.2	57.1	—	—
Mustang	—	—	—	54.0	38.1	—
Nortex 107	27.2	1.4	6.3	52.5	31.5	23.8
Southland	—	—	—	60.9	—	—
Victorgrain 48-93	—	6.6	5.8	69.4	47.3	—

*The tests in 1950 and 1953 were not harvested because of rust damage and severe lodging.

grain 48-93 has been the most productive in three years out of six; Fulgrain two years and Arlington one. Victorgrain 48-93 was among the best two yielding oats in every trial year. (Table 23).

Wheat

Anderson is highly resistant to leaf rust in the heading stage, moderately resistant to loose smut, susceptible to some races of stem rust, and moderately susceptible to mildew. In the seedling stage Anderson is susceptible to leaf rust. It has some resistance to Septoria leaf blotch. It is susceptible to soil-borne mosaic though this virus disease has not yet been of consequence in Mississippi.

Anderson is a beardless tall wheat but is resistant to lodging. It has darker green heads than the other wheats. Grain yields have been as good as those of the best varieties tested in Mississippi. Anderson has an intermediate to semi-erect type of growth in fall and winter and is a good grazing variety. It is a good milling wheat.

Atlas 66 is resistant to leaf rust and to some races of stem rust but is moderately susceptible to mildew, loose smut, leaf blotch, and soil-borne mosaic. In the seedling stage, Atlas 66 is susceptible to leaf rust. It is of medium height, and resists lodging. In the fall and winter, this variety has a semi-erect type of vegetative development and has been a good forage wheat. Its grain averages about 12% protein contrasting with 10% for certain other soft, red winter wheats such as Chancellor. This fact has made it especially valuable for blending purposes to Southeastern millers who have paid a premium for Atlas 66 grain.

Atlas 66 has a beardless head that tends to broaden at the tip rather than to taper as do the other recommended wheats.

Chancellor is moderately susceptible to leaf rust in the heading stage but is highly resistant in the seedling stage. It is resistant to soil borne mosaic but moderately susceptible to stem rust and susceptible to mildew, leaf blotch, and loose smut. Chancellor is beardless, of

Table 22. Oats, grain yields at State College, 1950-1954.

Variety	1950	1951	1952	1953	1954	5-year average
			Bushels per acre			
Alber	29.1	53.1	59.9	54.9	50.0	49.4
Arlington	22.4	56.8	42.4	61.3	50.9	46.7
Bonda	38.5	4.2	0.0	65.4	52.5	32.1
Camellia	19.8	45.9	44.3	44.0	51.8	41.6
Delair	10.3	49.7	42.2	37.0*	63.8	40.6
Delta Red 88	26.1	50.3	60.5	61.3	59.7	51.6
Fulgrain	21.9	58.6	64.4	70.1*	69.0	56.8
Madison County Red	28.4	51.8	63.3	50.1	—	—
Mustang	16.2	54.3	69.6	51.8	56.4	49.7
Nortex 107	30.1	49.1	41.7	54.0	54.7	45.9
Victorgrain 48-93	35.5	65.5	48.4	65.5*	63.1	56.6

*Bird damage before harvest.

Table 23. Summary of grain yield averages of oat varieties grown at six locations in Mississippi, 1948-1954.

Variety	1948	1949	1950	1951	1952	1953	1954	1950-54 average*
				Bushels per acre				
Alber	51.6	37.6	43.8	53.0	63.0	53.0	50.0	52.5
Arlington	—	—	42.4	54.3	63.6	64.4	50.9	55.1
Bonda (check)**	—	17.5	38.0	27.0	52.5	48.5	52.5	43.7
Camellia	33.5	29.5	39.0	40.8	49.5	47.7	51.8	45.7
Delair	35.1	43.3	26.6	48.8	63.1	39.5	63.8	48.3
Delta Red 88	54.2	36.7	44.6	44.6	63.5	62.8	59.7	55.0
Fulgrain	38.8	34.1	37.6	50.2	75.6	56.5	69.0	57.7
Madison County Red	47.8	29.2	43.4	55.1	66.1	59.7	—	—
Mustang	—	—	40.6	54.3	69.2	58.8	56.4	55.8
Nortex 107	44.5	38.0	46.0	50.0	56.8	59.6	54.7	53.4
Victorgrain 48-93	—	48.1	51.8	59.3	71.0	63.3	63.1	61.7

*Red "Rustproof" oats, (Delta Red 88 and Nortex 107), 5 year average 54.2
Victoria-derived oats, (Arlington, Fulgrain, Mustang, Victorgrain 48-93), 5 year average 57.5
**Not grown commercially in Mississippi.

A field of sod-seeded Atlas 66 wheat at the Brown Loam Experiment Station in 1954.

medium height, resistant to lodging, and is several days to a week earlier in maturity than other recommended wheats. Its vegetative growth in fall and winter is of a semi-prostrate nature as shown in Table 24. Chancellor is a good milling wheat.

Coastal is highly resistant to leaf rust in the adult stage but is susceptible in the seedling stage. This variety is susceptible to soil borne mosaic, to some races of stem rust, to powdery mildew, and to loose smut. Coastal has moderate resistance to leaf blotch. Coastal is beardless, tall, and has only moderate resistance to lodging. The protein content of its grain is high like that of Atlas 66 and it is a good milling wheat.

Coastal has a nearly erect habit of growth in fall and winter, producing in early seedings more fall growth

Table 24. Disease reactions and other characteristics of some commercial wheat varieties at State College, Mississippi.

Variety	Mature height	Date		Lodging 1951 to 1953*	Reaction to**			
		1/10 headed	Mature		Leaf rust	Stem rust	Powdery mildew	Loose smut
	In.	April	June	%				
Chancellor	49	12	3	22	MS	S	S	S
Atlas 66	48	25	7	20	R	MR	MS	S
Atlas 50	48	26	7	44	MR	MR	MR	S
Coker 47-27	52	22	3	26	R	MR	S	S
Coastal	48	22	5	52	R	MR	S	S
Taylor	53	24	7	37	R	MR	S	MR
Anderson	58	23	8	29	R	MR	MS	MR
Leap	56	24	4	43	MS	S	S	R
Purplestraw	46	8	2	41	S	S	S	S

*Volunteer ryegrass biased the lodging results in 1954 which have therefore been omitted.

**Meanings of symbols: R—resistant, MR—moderately resistant, MS—moderately susceptible, S—susceptible.

than the other recommended wheats. Coastal may not always be hardy in the most northern part of Mississippi though it has not yet winter killed in tests in that region.

Coker 47-27 is resistant to leaf rust in the adult stage and susceptible in the seedling stage. Coker 47-27 is susceptible to mildew, to some races of stem rust, to soil borne mosaic and to loose smut. It has some resistance to leaf blotch. Coker 47-27 is beardless and tall but resists lodging. Its vegetative growth is semi-erect like that of Atlas 66 and it is a good grazing wheat. The milling quality of Coker 47-27 is good.

Varieties not recommended include Atlas 50 and Taylor which appear to have no present advantage over one or more of the other wheats in Mississippi.

Rust susceptible older varieties are Redhart, Hardired, Sanford and Purplestraw. Varieties that have come into the state from more northern areas and which are not recommended are Vigo, Royal, Triumph and others.

Stoneville: The average yields of 14 wheat varieties grown at the Delta Branch Experiment Station are shown in Table 25. The agronomic characteristics of the same varieties are shown in Table 26.

Table 26 is of interest in that it shows the improved varieties resulting from an expanded southern breeding program. For years Redhart was the standard wheat. Yields frequently were very low because of leaf rust epidemics. Not until the development of Chancellor was wheat production profitable in the Delta. Other recommended varieties developed in subsequent years are Atlas 66, Coker 47-27, Anderson, and Coastal. Chancellor is the earliest maturing variety and Atlas 66 and Anderson the latest varieties. Coker 47-27 and Coastal ripen a few days before Atlas 66 and Anderson. All the recommended varieties stand well and give satisfactory yields of of good quality grain. All the varieties are quite hardy with the exception of Coastal, which should be restricted to the Southern fourth of the state.

McNeil: Seven varieties have been tested at McNeil one to three years. Coastal has been the highest producer, averaging 26.1 bushels or 1566 pounds per acre, 1952- to 1954 (Table 27). Chancellor with 23.4 bushels and Coker 47-27 are next in rank.

Newton: Coastal ranked highest in two year averages with 28.4 bushels per acre followed by Coker 47-27, Chancellor and Atlas 66 (Table 27). The differences in yield between these varieties, especially between the top four, are too small to signify real differences in yielding ability. Any one of the high ranking varieties is suitable for grain production at Newton, except Chancellor which is now too susceptible to leaf rust.

Brooksville: Coastal among four varieties had the top ranking yield, 27.7 bushels per acre, though the yields of the four varieties were close together (Table 27). Test weights were less than standard. Wheat at Brooksville has been very resistant to lodging.

State College: In Table 28 are shown some of the varieties in the Southern uniform grain yield test. Highest average yields were made by Anderson, Taylor, and Chancellor. Atlas 66, Leap, and Purplestraw were the lowest yielders. Average test weights were below standard but were only seriously low for the two Atlas strains, for Leap and for Purplestraw.

Holly Springs: Yields during six years are shown in Table 29. Average yields are given for the first two years and for all six years. Chancellor, Taylor, and Anderson had the highest six-year average yields. However, all varieties were much alike in their average yields except Leap and Purplestraw which were much lower.

Test weights per bushel at Holly Springs have been very good. The three year average for Coker 47-27 was 62 pounds. The Atlas varieties and Leap were under 60 pounds.

Table 25. Yields of 14 varieties of wheat over a nine-year period at the Delta Branch Eperiment Station, Stoneville, Mississippi.

Variety	Years									Comparable average*	Rank	% of Chancellor
	1946	1947	1948	1949	1950	1951	1952	1953	1954			
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.		%
Hardired	27.5	22.2	23.0	37.4	32.5	—	—	—	—	34.2	8	82
Redhart	23.4	19.0	9.3	11.1	14.5	—	—	—	—	21.2	14	44
Sanford	36.5	22.1	23.3	37.7	29.0	—	—	—	—	35.4	7	85
Purcam	30.1	29.3	22.9	39.4	28.0	—	—	—	—	35.6	6	86
Purplestraw	25.6	20.8	14.6	19.5	21.2	25.2	42.1	39.4	34.4	27.0	12	68
Leap	24.6	26.3	11.6	29.4	27.0	32.9	40.2	41.2	32.8	29.6	11	74
Taylor	30.4	30.5	27.2	44.4	30.7	42.1	55.8	45.3	38.4	38.3	3	96
Chancellor	39.4	31.8	27.8	44.9	30.2	41.3	53.2	47.1	42.1	39.8	2	100
Anderson	—	—	24.9	39.7	32.7	37.7	52.7	43.4	42.7	37.7	5	96
Atlas 50	—	—	—	31.0	26.9	39.9	44.6	43.6	36.5	33.2	10	86
Atlas 66	—	—	—	39.4	30.9	37.5	47.0	44.7	32.3	34.7	9	90
Coker 47-27	—	—	—	42.5	30.0	45.7	57.9	46.1	42.4	40.2	1	102
Coastal	—	—	—	—	28.5	41.5	49.2	49.8	42.4	37.8	4	99
Vigo	—	—	—	—	—	—	—	38.7	26.6	26.2	13	73

*Comparable average is based on the yields of Purplestraw, Leap, Taylor and Chancellor.

Table 26. Average agronomic characteristics of 14 varieties of wheat grown at the Delta Branch Experiment Station, Stoneville, Mississippi.

Variety	Test weight	Plant height	Lodged plants	Date	
				Headed	Ripe
	Lbs.	In.	%	April	May
Hardired	55	48	60	17	19
Redhart	53	40	76	17	15
Sanford	57	46	31	14	17
Purcam	56	50	32	23	23
Purplestraw	55	47	43	10	17
Leap	57	58	17	25	27
Taylor	58	56	12	23	26
Chancellor	57	52	15	12	20
Anderson	58	56	8	23	26
Atlas 50	57	51	21	23	25
Atlas 66	57	51	17	23	25
Coker 47-27	59	53	7	20	24
Coastal	58	49	26	19	23
Vigo	58	58	0	28	June 2

Table 27. Grain yields per acre and test weights per bushel for some wheat varieties grown at the McNeil Substation, Newton, and Brooksville.

Variety	McNeill		Newton Average of 1953 and 1954	Brooksville	
	Average yield 1952-54	1952 bushel weight		Average of 1953 & 1954	
				Yield	Bu. wt.
	Bu.	Lbs.	Bu.	Bu.	Lbs.
Chancellor	23.4	51.0	26.3	23.9	57.1
Atlas 66	14.2*	—	25.2	23.7	58.2
Coker 47-27	21.7	56.4	27.0	26.9	58.4
Coastal	26.1	58.6	28.4	27.7	57.6
Taylor	18.9	52.0	24.4	—	—
Anderson	18.6	51.6	22.8	—	—
Purplestraw	13.0**	—	22.2**	—	—

*1953 and 1954 only.
**1953 only.

Table 28. Yields of grain per acre of wheat varieties at State College, Mississippi, for the years 1951 through 1954 and average weights per bushel.

Variety	1951	1952	1953	1954	4-year average	Rank	Average test wt. per bu.
	Bu.	Bu.	Bu.	Bu.	Bu.	No.	Lbs.
Chancellor	35.4	41.1	38.5	29.6	36.2	2.5	57
Atlas 66	31.8	39.8	27.6	25.4	31.2	6	55
Atlas 50	24.8	34.7	24.5	25.9	27.5	7	54
Coker 47-27	35.8	40.4	29.0	32.8	34.5	5	58
Coastal	39.1	35.5	33.5	30.8	34.7	4	57
Taylor	35.4	47.0	32.5	29.8	36.2	2.5	57
Anderson	43.3	44.2	29.5	28.2	36.3	1	58
Leap	31.0	23.1	21.1	13.4	22.2	9	55
Purplestraw	25.1	28.8	23.0	18.7	23.9	8	57
Least significant differences, 5% level	4.8	6.1	8.3	3.8	—	—	—
CV	11%	16%	20%	24%	—	—	—

Table 29. Yields of grain per acre of wheat varieties at Holly Springs, Mississippi for the years 1949 through 1954.

Variety	Years						Averages		Test wt. per bushel; average of 1952 & 1954
	1949	1950	1951	1952	1953	1954	1949 1950	1949 1954	
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Lbs.
Chancellor	31.3	20.0	23.4	34.4	—*	29.4	25.7	27.7	60
Atlas 66	29.8	18.8	20.7	36.1	24.8	22.1	24.3	25.4	59
Atlas 50	27.8	17.5	17.7	30.2	28.1	28.0	22.7	24.9	59
Coker 47-27	22.0	23.9	15.5	45.2	19.3	26.3	23.0	25.4	62
Coastal	—	24.6	17.2	38.1	25.6	14.6	—	24.0	60
Taylor	31.3	23.6	19.8	36.5	21.1	33.6	27.5	27.7	60
Anderson	31.0	21.1	17.5	36.8	18.6	32.4	26.1	26.2	60
Leap	24.4	13.0	9.8	31.4	15.8	24.4	18.7	19.8	59
Purplestraw	15.9	9.4	14.2	24.2	—*	18.1	12.7	16.4	61
Sanford	18.0	13.3	—	—	—	—	15.7	—	—
Redhart 5	7.1	10.0	—	—	—	—	8.6	—	—
Hardired	36.0	17.0	—	—	—	—	26.5	—	—
Least significant difference 5% level	4.4	4.4	5.7	6.4	6.9	4.0	—	—	—
CV	—	17%	30%	14%	23%	22%	—	—	—

*Damaged by birds when ripe.

Table 30. Disease reactions where known and some other characteristics of some of the barley varieties tested at State College, Miss.

Variety	Growth habit*	Lodging resistance	Reaction to**						Bacterial blight	Plant height	Relative maturity
			Mildew	Scald	Leaf rust	Stem rust	Net blotch	Loose smut			
Colonial 2	P	Fair	S	MS	MS	S	S	S	S	Med.	Early
Wong	P	Fair	MR	S	S	—	S	S	S	Med.	Early
Fayette 2-1	P	Poor	S	R	S	R	S	S	S	Med.	Early
Cordova	P	Good	MR	R	S	S	S	R	—	Med.	Early
Harbine	P	Good	S	R	R	S	S	R	S	Med.	Early
Texan	P	Good	R	R	S	S	S	R	R	Med.	Early
Kenbar	P	Good	R	R	MS	S	S	MR	S	Tall	Early
Goliad	SE	Good	MS	MS	S	—	S	R	S	Tall	Early
Jackson 1	P	Fair	S	S	MS	S	S	S	—	Tall	Early
Kentucky 1	P	Fair	S	R	MS	—	S	S	S	Tall	Early

Meanings of abbreviations:
* P—prostrate, SP—semi-prostrate, SE—semi-erect, E—erect.
**R—resistant, MR—moderately resistant, MS—moderately susceptible, S—susceptible.

Table 33. Yields of grain per acre of some barley varieties grown at State College from 1947 through 1954 and averages of yields and bushel test weights.

Variety	Grain yield per acre by years*								Averages				Weights per bushel	
	1947	1948	1949	1950	1951	1952	1953	1954	1949-1954	1950-1954	1951-1954	1952-1954	1951-1954	1952-1954
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
Colonial 2	—	—	—	14.5	59.8	39.5	40.5	21.1	—	35.1	40.2	33.7	40	39
Wong	36.7	9.8	23.1	13.6	34.8	43.2	38.8	17.9	28.6	29.7	33.7	33.3	41	41
Fayette 2-1	—	—	—	—	51.8	43.3	51.7	32.4	—	—	44.8	42.5	46	45
Cordova	—	—	41.6	26.6	43.9	42.8	51.6	35.3	40.3	40.0	43.4	43.2	47	47
Harbine	—	—	34.8	32.8	39.2	42.6	41.5	33.8	37.5	38.0	39.3	39.3	45	45
Texan	46.4	19.7	42.1	15.7	42.1	40.5	57.6	34.3	38.7	38.0	43.6	44.1	45	45
Kanbar	—	—	—	—	—	63.4	47.2	27.4	—	—	—	46.0	—	47
Goliad	—	—	—	—	36.6	52.2	50.9	34.8	—	—	43.6	46.0	47	48
Jackson 1	49.4	21.1	41.8	23.3	37.1	—	—	—	—	—	—	—	—	—
Kentucky 1	38.4	16.5	30.5	12.7	26.8	—	—	—	—	—	—	—	—	—
Least significant difference, 5% point	—	—	—	**	11.3	7.2	8.7	9.2	—	—	—	—	—	—
CV	—	—	—	—	17%	13%	12%	19%	—	—	—	—	—	—

*Weight of grain per bushel used in converting plot yields to bushels per acre was 48 lbs.
**No significant difference between averages.

Barley

Kenbar is tall and usually stands well unless harvesting is considerably delayed. Its heads are compact, fully awned, and the awns are semi-smooth in texture. It is highly resistant to powdery mildew, resistant to scald, moderately resistant to leaf rust, and resistant to some races of loose smut, but is susceptible to stem rust, and net blotch.

Kenbar matures earlier than most recommended varieties of small grains and about the same time as Delair oats. In habit of vegetative development in fall and winter, Kenbar is prostrate. Because of its susceptibility to net blotch and its cold requirement for normal heading, Kenbar is not recommended for the southern one-fourth of the state. The characteristics of Kenbar and some other varieties are shown in Table 30.

Varieties not recommended are Texan, Calhoun, Wong, Colonial, and Jackson Smoothawn. These varieties have been inadequate in some respects.

Two types of barley yield tests have been conducted. One is the Southern uniform variety test first grown at State College in 1947. The other test has been of local selections and of foreign introductions grown in comparison with some commercial varieties.

Stoneville: Average yields and agronomic characteristics (Tables 31 and 32) of 17 barley varieties grown at the Delta Branch Experiment Station are presented.

Yields of several varieties have been relatively good but weak straw and a lack of disease resistance have restricted the use of barley. New varieties in the process of development offer much promise of overcoming these difficulties.

State College: Results for most of the varieties in the Southern uniform variety yield test are given in Table 33. A sufficient number of averages are given to compare any two varieties grown in the same years.

Cordova and Texan were tested 1949 to 1954 with averages of 40.3 and 38.7 bushels, respectively. During the last three years of the test period, Kenbar and Goliad, had 46 bushel averages. Texan yielded 44.1 bushels followed by the other entries.

Barley, including Kenbar, has often lodged quite heavily at State College. A contributing factor has been that the test has usually been grown on land fallowed one year. Kenbar, however, in commercial fields has usually stood well. Test weights per bushel (Table 33) have been normal or one to several pounds less.

New barley strains and some foreign introductions have been tested at the branch Experiment Stations. These tests show that improved varieties are available and encourage further testing.

Rye

Abruzzi rye, like all rye varieties, is cross-fertilized and is quite variable. It is more of a type than a variety,

Table 31. A yield comparison of 19 barley varieties grown at the Delta Branch Experiment Station, Stoneville, Mississippi.

Variety	Years							Comparable yield Texan	Rank	of Percent Texan
	1947	1948	1949	1951	1952	1953	1954			
	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.			%
Hooded 5	31.7	44.6	39.0	—	—	—	—	45.1	8	85
Calhoun	34.3	30.2	46.3	—	—	—	—	43.6	9.5	82
Smooth Awn 85	45.6	32.6	44.8	—	—	—	—	47.7	4	90
Hooded Y743	44.8	35.7	46.1	31.5	—	—	—	47.1	5	89
Sunrise	41.6	19.0	35.6	30.3	—	—	—	39.2	15	71
Fayette	29.7	18.4	48.8	33.1	64.5	—	—	39.4	14	76
Jackson 1	33.2	29.8	51.7	44.9	47.3	—	—	41.9	13	30
Kentucky 1	34.2	28.0	35.1	49.8	43.8	—	—	38.7	16	74
Wong	22.6	23.5	42.4	26.9	66.4	—	—	36.9	17	71
Texan	52.6	31.6	51.7	41.8	79.8	59.6	46.6	52.0	3	100
Harbine	—	—	52.2	44.4	59.7	—	—	46.3	6	90
Piedmont	—	—	26.7	50.8	77.6	—	—	45.9	7	39
Calhoun M450-4	—	—	—	50.2	53.0	—	—	42.8	12	85
Colonial 2	—	—	—	48.4	56.4	—	—	43.6	9.5	86
Fayette 2-1	—	—	—	32.1	71.8	51.8	—	43.5	11	86
Goliad	—	—	—	48.6	79.6	51.5	60.5	55.1	1	105
Kenbar	—	—	—	—	83.5	56.6	54.0	54.7	2	104

Table 32. Average agronomic characteristics of 19 barley varieties grown at the Delta Branch Experiment Station, Stoneville, Mississippi.

Variety	Test weight	Date headed	Date ripe	Lodged	Plant height
	Lbs.	April	May	%	In.
Hooded 5	34	7	9	62	42
Calhoun	41	17	4	52	38
Smooth Awn 86	42	18	18	49	43
Hooded Y743	36	14	13	60	38
Sunrise	38	18	14	95	37
Fayette	39	15	15	46	37
Jackson 1	44	18	21	22	39
Kentucky 1	42	24	22	53	42
Wong	39	14	15	30	37
Texan	40	10	19	42	37
Harbine	42	21	20	14	42
Piedmont	41	12	18	20	41
Calhoun M450-4	44	19	18	4	41
Colonial 2	37	21	20	9	37
Fayette 2-1	39	12	14	27	42
Goliad	43	6	5	22	44
Kenbar	41	11	16	57	42

consisting of numerous strains differing in growth habit, maturity date, disease reaction, and yielding ability.

The Abruzzi rye used in Mississippi is tall, early, and fast growing. Sometimes it will make more growth by mid-winter than the other small grains. It resists cold injury as much as the hardier varieties of other small grains in the South. Usually at least one third of the plants are fully susceptible to leaf rust. Most plants are resistant to stem rust and mildew.. Anthracnose susceptibility is widespread. Some plants of Abruzzi begin heading as early as January though most will not head until March and April. Abruzzi is tall and moderately resistant to lodging. It is partially awned.

Balbo rye is not recommended because it usually yields less forage and grain than Abruzzi rye. Balbo is more prostrate in growth during fall and winter than Abruzzi. It is the most winter hardy of Southern small grain varieties. Reactions to disease are similar to those of Abruzzi.

Numerous samples of Abruzzi collected from commercial seedsmen and growers in the South were tested at four locations for grain yields as shown in Table 34. Two consecutive grain yield tests are reported.

Stoneville: Rye has been tested only once. The strains tested and observations made on them are shown in Table 34. The Abruzzi strains yielded from 44 to 52 bushels per acre and all ranked higher than Balbo. A 52 bushel yield of rye is equal to 2912 pounds of grain. Of the eight rye strains, only four lodged excessively. Abruzzi headed about March 30 and ripened May 25. Balbo headed April 3 and ripened May 27 in 1954.

McNeil: The strain obtained from Richmond, Virginia, ranked first with 22.9 bushels per acre in two year averages (Table 34). The Hattiesburg strain ranked second with a yield of 21.1 bushels. Balbo yielded an average of 3.9 bushels.

State College: The Virginia strain with 38.4 bushels and Lot 5 with 37 bushels were well ahead of the other collections. Test weights per bushel were good for all entries.

Abruzzi in 1953 was one-tenth headed by the middle or latter part of March, but in 1954 headed between April 2 and 4 because of different weather conditions. Maturity dates were recorded in 1954 and the strains seemed all to mature at the same time under the influence of dry weather. Lodging has not been serious, varying between one percent for the Florida strain to 19 percent for Balbo. The Virginia strain was shortest at 49 inches but no variety exceeded 55 inches.

Holly Springs: The Virginia strain and the Atlanta strain were highest yielders with 36.4 and 35.5 bushels per acre (Table 34). Balbo and the Hattiesburg strain yielded the least. Test weights were good and sometimes ex-

Table 34. Average yields of grain per acre and test weights per bushels of some rye varieties tested, 1952-54, at State College and Branch Stations near Stoneville, McNeil, and Holly Springs.

		McNeil	State College		Stoneville**		Holly Springs	
Variety	Source	Yield per acre	Yield per acre	Test* wt. per bu.	Yield per acre	Test wt. per bu.	Yield per acre	Test wt. per bu.
		Bu.	Bu.	Lb.	Bu.	Lb.	Bu.	Bu.
Abruzzi	Richmond, Va.	22.4	38.4	56	44.3	56	36.4	57
Abruzzi	Atlanta, Ga.	21.1	37.0	56	44.6	56	35.5	57
Abruzzi	Miss. Sel., State College	13.1	32.7	55	44.8	54	31.6	55
Abruzzi	North Carolina	13.0	32.5	54	51.9	55	31.4	56
Abruzzi	Hattiesburg, Miss.	10.1	29.5	56	44.1	56	29.1	57
Balbo	Memphis, Tennessee	3.9	20.7	54	40.7	54	24.2	55

*Standard bushel weight for rye is 56 pounds.
**1953-54 only.

ceeded the standard of 56 pounds. Rye has been very resistant to lodging at Holly Springs. Plant height has varied between 57 and 63 inches.

USE OF SPRING VARIETIES

Some Mississippi growers have obtained seed of spring varieties of small grain, especially oats, that were brought in from northern states and sold for feed at prices lower than seed grain prices. Such lots of seed were sometimes plump and bright and often superior in appearance to locally produced seed grain. When sown, these varieties have been reported to have given satisfactory forage and grain yields though there may have been unreported losses from cold and diseases.

Spring oats cannot be expected to consistently survive Mississippi winters or to be as disease resistant as varieties bred in the South for the South. Farmers are cautioned about their continued use.

FORAGE YIELDS

Varieties of small grains were tested for forage yielding abilities in large plots on a uniform basis beginning in 1949.. Twelve to 16 varieties were tested each year. Ryegrass was also included for comparison the last two years. Seeding was at the rate of 120 pounds per acre for the cereals and 25 pounds per acre for ryegrass. In most instances seed was broadcast by hand and the plots then harrowed and cultipacked. Seeding was done in early to mid-September. At McNeil seeding was delayed until October to reduce the likelihood of army worm infestation.

Fertilization was usually at the rate of 120 pounds of nitrogen, 90 pounds of phosphate and 30 pounds of potash per acre. One-third of the nitrogen was applied at seeding time and one-third in late December or January if sufficiently warranted by the removal of fall growth. The remaining one-third of the nitrogen was added in March if a grain crop was to be harvested. Plots were usually six by twenty feet in size and five replicates were sown.

These tests were seeded in two or more of the four years at Branch Stations at McNeil, Newton, Raymond, Brooksville, Verona, Pontotoc, and Holly Springs. The tests at Verona and Brooksville are not reported here because of insufficient data. At Pontotoc the test was seeded on both flatwoods and Pontotoc ridge soils. Forage yields were converted to dry weights the last two years at all locations but only at McNeil all four years.

Germination of the seed and vigorous growth were sometimes retared by inadequate fall rains. The first harvest of forage was therefore sometimes delayed until after January 1. Plots were clipped when the plants were six to 12 inches high. The total number of clippings made varied from two to five per season at any location. The soil was high in clay at most of the sites where the tests were conducted and with frequent rains would not often permit operation of a mower, one reason more clippings were not made. Clipping to simulate grazing was done either with a small power mower or with a tractor and a five foot cutter bar.

The results of the tests are shown as bar graphs over a four-year period at

Table 35. Average dry forage yields in tons per acre for two crop years, 1951-52 and 1952-53, at four Mississippi Branch Experiment Stations.

Variety	Yields per acre by stations for first and total clippings															
	McNeil Sub-station				Newton				Raymond				Holly Springs			
	First*	Rank	Total	Rank	First	Rank	Total	Rank	First	Rank	Total	Rank	First	Rank	Total	Rank
	Ton	No.	Tons	No.	Ton	No.	Tons	No.	Ton	No.	Tons	No.	Ton	No.	Tons	No.
Arlington	.37	7	1.79	9	.26	3	2.61	1	.59	4	2.25	3	.22	7	2.43	1
Camellia	.61	1	1.82	7	.15	8	2.18	5	.45	8.5	2.14	9	.12	8.5	1.89	9
Delair	.59	2	1.95	2.5	.34	2	2.12	7.5	.63	2.5	2.53	1	.29	4	1.90	8
Delta Red 88	.58	3	1.89	5.5	.15	8	2.13	6	.46	7	2.12	10	.12	8.5	1.85	10
Mustang	.28	10.5	1.81	8	.09	11	2.08	9	.39	10	1.91	11	.10	10	2.30	3
Nortex 107	.49	4	1.89	5.5	.15	8	2.57	2	.36	11	1.87	12	.08	11	1.96	7
Victorgrain 48-93	.40	5	1.95	2.5	.20	5	2.28	3	.55	5	2.19	7	.23	6	2.23	4
Atlas 66	.39	6	1.90	4	.16	6	2.04	10	.52	6	2.24	4	.43	2	2.07	6
Chancellor	.28	10.5	1.27	11	.13	10	2.12	7.5	.45	8.5	2.23	5	.27	5	2.15	5
Coastal	.32	9	2.03	1	.39	1	2.21	4	.63	2.5	2.20	6	.38	3	1.81	11
Coker 47-27	.34	8	1.76	10	.23	4	1.74	12	.83	1	2.27	2	.57	1	1.77	12
Ryegrass	.11	12	1.18	12	.05	12	1.97	11	.24	12	2.15	8	.07	12	2.37	2

*Refers to the first harvest of forage.

McNeil, Newton, Raymond, and Holly Springs and for a two-year period at Pontotoc. Yields are reported as dry weights where available but otherwise as green weights. That data on varieties recently added to the test might be shown, two years average yields for 12 varieties are given for four stations in Table 35.

The second years test was not completed at Raymond. Though the third years test at Raymond was systematically rather than randomly seeded, it was included in the summarization. Rabbits harvested a substantial amount of forage from some varieties, especially Chancellor, in the test at Newton.

Growing conditions were highly variable during the four years of the experiment. The first crop year was very mild and Delair, one of the more erect growing and less hardy varieties produced the most forage at nearly all locations. In the crop year of 1950-51, cold weather caused the soil to heave and destroyed the experiment at Brooksville in November. In the same year, the test at McNeil was destroyed by cold in February.

Grain yields were sometimes obtained by harvesting forage from only one-half of each plot late in the season and the other half permitted to produce seed. Only in 1951-52 were grain yields obtained at most stations.

McNeil: Five oat and two wheat varieties were tested all four crop years at McNeil. Forage yields of eleven small grain varieties and ryegrass for the last two years are given in Table 35. Grain yields were measured after clipping at McNeil the last two test years. Their averages are shown in Table 36. Grain yields the third test year at McNeil are included in Table 37.

Camellia, Delair and Delta Red 88 oats produced the most early forage at McNeil in both the four year averages in the bar graph and the two year averages (Table 35). Wheat made less early growth than oats though greater subsequent growth was made by two of the wheats, Atlas 66 and Coastal.

Table 36. Average yields of grain after indicated number of forage clippings for 1951-52 and 1952-53 at McNeill and on two locations at Pontotoc.

Variety	Grain yields per acre by stations					
	McNeil		Pontotoc ridge		Pontotoc, flatwoods	
	Yield	Rank	Yield	Rank	Yield	Rank
	Lbs.	No.	Lbs.	No.	Lbs.	No.
Arlington	206	10	1841	4	2188	1
Camellia	916	4	1613	8	1696	5
Delair	485	9	1076	11	1499	7
Delta Redd 88	983	3	1862	3	1529	6
Nortex 107	1019	2	1790	5	1881	3
Mustang	183	11	1622	7	1891	2
Victorgrain 48-93	537	8	2064	1	1828	4
Atlas 66	876	5	1779	6	1427	8
Chancellor	586	7	1987	2	1425	9
Coastal	1029	1	1496	10	1274	11
Coker 47-27	855	6	1603	9	1417	10
No. of clippings of forage before grain harvest	2 in '52 1 in '53		1 in '52 2 in '53		2 in '52 1 in '53	

Table 37. Yields of grain at five locations for 1951-52 after the indicated number of clippings for forage.

Variety	Location of test							
	McNeil	Raymond	Newton	Pontotoc ridge	Pontotoc flatwoods	Average		Rank
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Bu.	No.
Alber oats	1191	1568	1106	1405	1711	1396	43.6	8
Arlington	244	2347	874	2149	2625	1648	51.5	1
Camellia	1234	1312	891	1439	1822	1340	41.9	9
Delair	563	1234	953	1139	2162	1210	37.8	12
Delta Red 88	1330	1588	1117	1918	2072	1605	50.2	3
Mustang	238	1975	1384	1820	2489	1581	49.4	4
Nortex 107	1490	1747	1165	1499	2169	1614	50.4	2
Victorgrain 48-93	444	1941	965	2104	2200	1531	47.8	5
Atlas 66 wheat	1069	1457	840	1888	1746	1400	23.3	7
Chancellor	639	2081	1225	1870	1771	1517	25.3	6
Coker 47-27	1214	1365	658	1545	1586	1274	21.2	10
Coastal	1316	1200	651	1640	1488	1259	21.0	11
Harbine barley	833	624	543	872	507	676	14.1	13
Balbo rye	186	194	54	950	624	402	7.2	14
No. of clippings of forage before grain harvest	2	2	2	1	1			
Least significant difference, 5% level	223	465	277	553	604			
CV	30.9%	26.1%	25.1%	27.2%	26.9%			

Delta Red 88, Atlas 66 and Coastal appear to be the best forage varieties tested at McNeil.

Grain yields after clipping were about equally high for several of the wheat and oat varieties (Table 36 and 37) for the one and two year periods, respectively. Delta Red 88, Nortex 107, and Camellia oats, Coastal, Coker 47-27, and Atlas 66 wheat were the top grain producers.

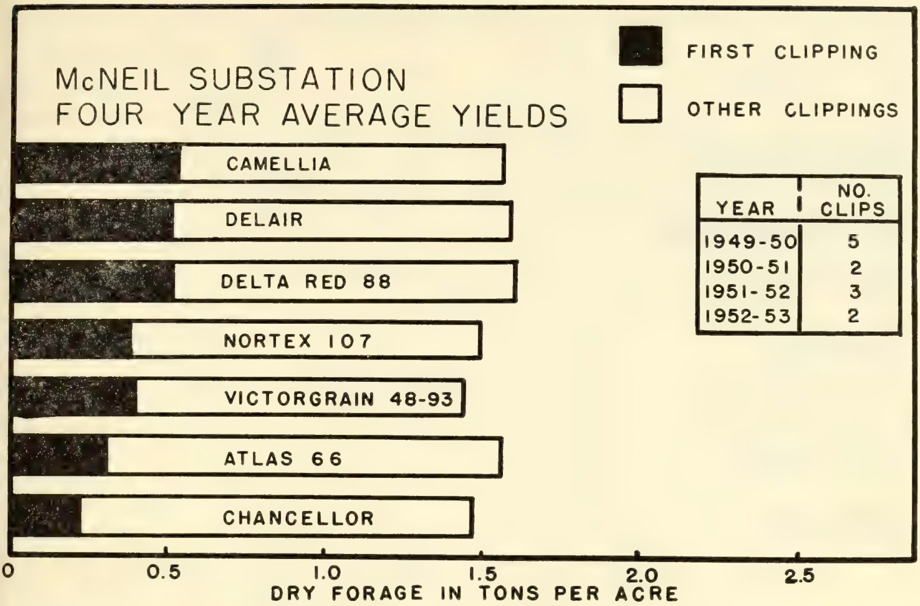
Abuzzi rye and Kenbar barley tested only during the fourth year, ranked third and fourteenth in first and total forage yields respectively. In grain yields Abruzzi ranked ninth and Kenbar eleventh.

Newton: Camellia, Delair, and Delta Red 88 oats produced more early and total growth than other oats or wheat varieties in four year averages. However, during the last two years of the test (Table 35) Coastal wheat ranked first in early growth and fourth in total growth. Arlington oats was productive during the two years it was tested, ranking third in early growth and first in total growth.

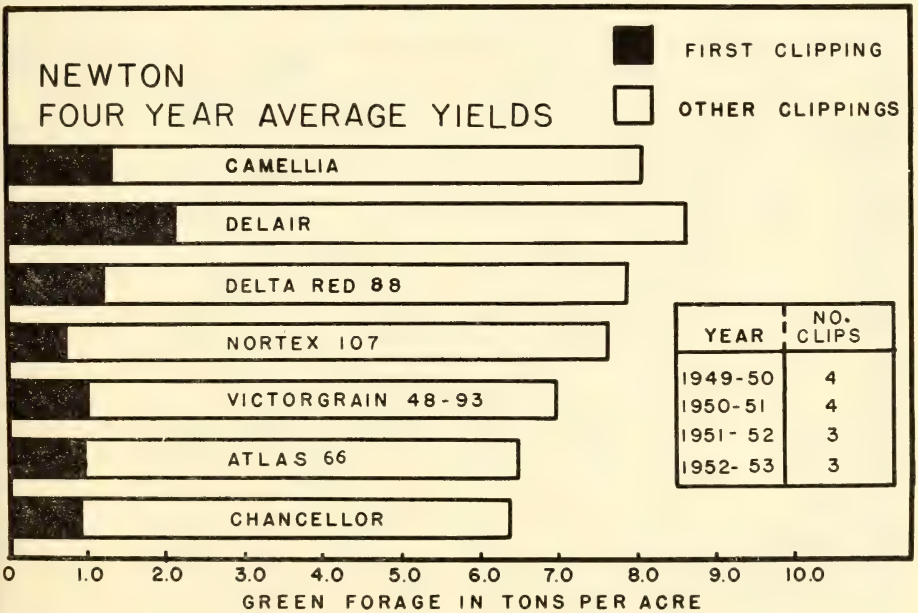
Yields of grain after two clippings of forage in 1951-52 showed Mustang and Chancellor to rank first and second. Nortex 107 and Delta Red 88 were third and fourth, respectively.

Abruzzi rye and Kenbar barley entered in the last year of the test, ranked sixth and tenth in first and total yields, respectively.

Raymond: Camellia and Delair had



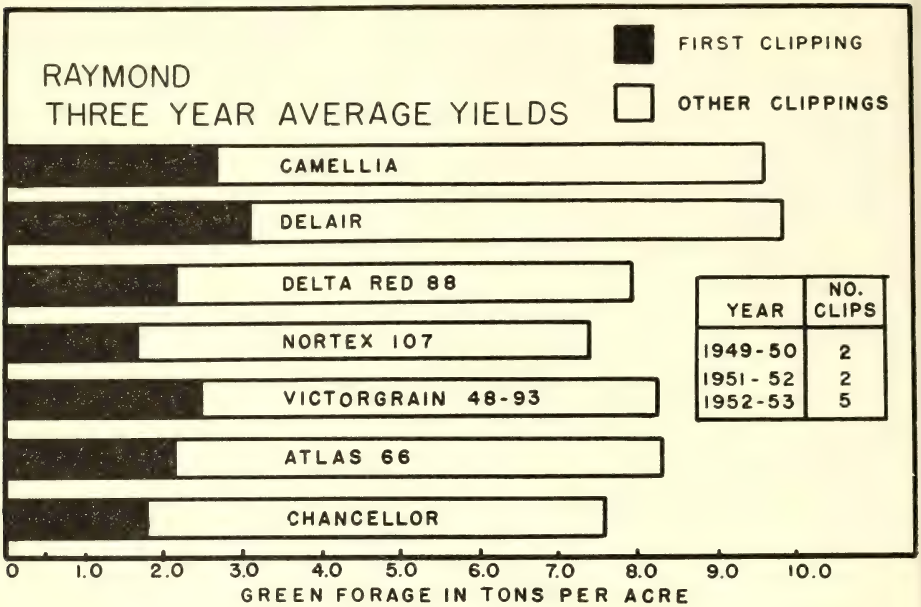
YEAR	NO. CLIPS
1949-50	5
1950-51	2
1951-52	3
1952-53	2

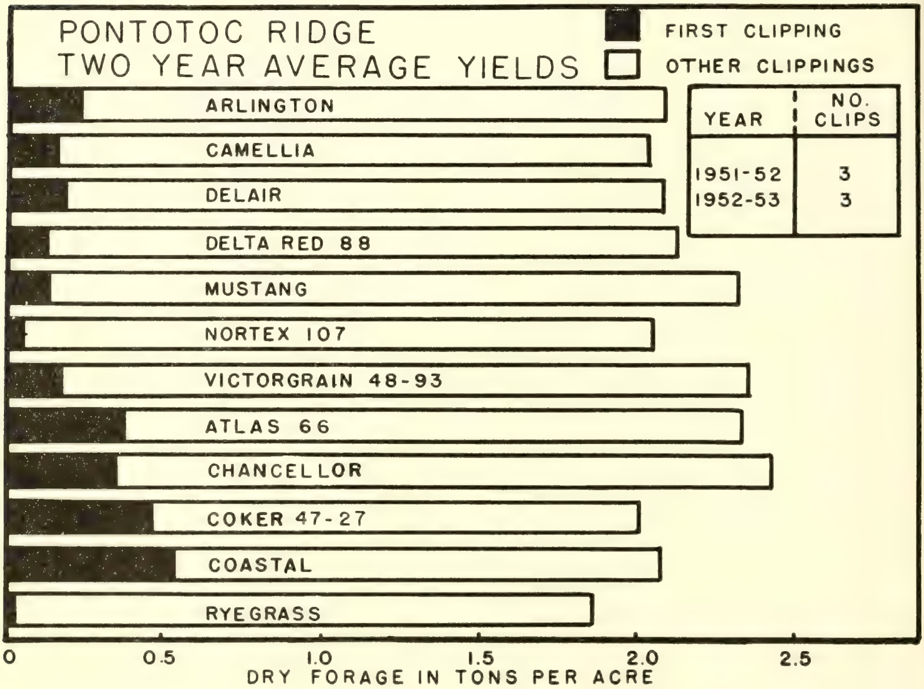


YEAR	NO. CLIPS
1949-50	4
1950-51	4
1951-52	3
1952-53	3

the highest yields of green forage. Victorgrain 48-93, Atlas 66, and Delta Red 88 made good early growth and total yields. In the last two year period (Table 35), Coker 47-27 wheat ranked first and second in early and total growth, respectively. Arlington, Delair, Victorgrain 48-93 and Atlas 66 were also high producers.

During cold winter weather at Raymond, the experimental wheat pastures showed good vegetative development


RAYMOND
THREE YEAR AVERAGE YIELDS
FIRST CLIPPING
OTHER CLIPPINGS
CAMELLIA
DELAIR
DELTA RED 88
NORTEX 107
VICTORGRAIN 48-93
ATLAS 66
CHANCELLOR
YEAR
NO. CLIPS
1949-50 2
1951-52 2
1952-53 5
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
GREEN FORAGE IN TONS PER ACRE


PONTOTOC RIDGE
TWO YEAR AVERAGE YIELDS
FIRST CLIPPING
OTHER CLIPPINGS
ARLINGTON
CAMELLIA
DELAIR
DELTA RED 88
MUSTANG
NORTEX 107
VICTORGRAIN 48-93
ATLAS 66
CHANCELLOR
COKER 47-27
COASTAL
RYEGRASS
YEAR
NO. CLIPS
1951-52 3
1952-53 3
0
0.5
1.0
1.5
2.0
2.5
DRY FORAGE IN TONS PER ACRE

while oat pastures were more inclined toward dormancy, increasing the trend toward adoption of wheat for winter pasture use in that area.

Grain yields after clipping twice were highest for Arlington, Chancellor, Mustang, and Victorgrain 48-93 (Table 37).

An Abruzzi rye strain and Kenbar barley both tested in only the fourth year ranked last of all entries tested.

Pontotoc Ridge soil type: Wheat yielded the most early forage in the two years tested. Chancellor and Atlas 66 wheat, Mustang and Victorgrain oats had the highest ranking total yields. The greater growth of wheat during the coldest winter weather in relation to growth of oats was especially striking at Pontotoc on Ridge soil.

Grain yields after one or two clippings were high for quite a few of the varieties shown including both oat and wheat entries.

Abruzzi rye and Kenbar barley were in the test the fourth year. The rye ranked fifth in early growth and fourth in total yield among 16 entries. Kenbar was thirteenth and sixth, respectively. In grain yields after two clippings, Abruzzi ranked second with 2084 pounds of grain per acre and Kenbar ranked last.

Pontotoc Flatwoods soil: The more erect growing wheat and oat varieties produced the most early forage but in total growth were behind the more prostrate varieties, except for Delair. Mustang, Arlington and Delair were highest in total yield. The oat varieties yielded more grain after one or two clippings than the wheat varieties.

Abruzzi rye and Kenbar barley were in the test in 1952-53. Abruzzi ranked fourth in early growth and fifth in total growth making it a good producer. In grain yields after two clippings Abruzzi ranked ninth among 15 entries. The Flatwoods soil test site was too acid for Kenbar which made poor growth.

Holly Springs: In yields from first clippings during the four year test period, Atlas 66 exceeded Chancellor while Delair, Camellia and Delta Red exceeded the other two oats. All varieties but Camellia were much alike in total yields though the two wheats and Victorgrain 48-93 ranked highest.

First clipping yields during the last two years (Table 35) were considerably higher for Coker 47-27, Atlas 66, and Coastal than for all other entries. In total yields Arlington, annual ryegrass, and Mustang ranked highest. Chancellor and Atlas 66 wheats were fifth and sixth.

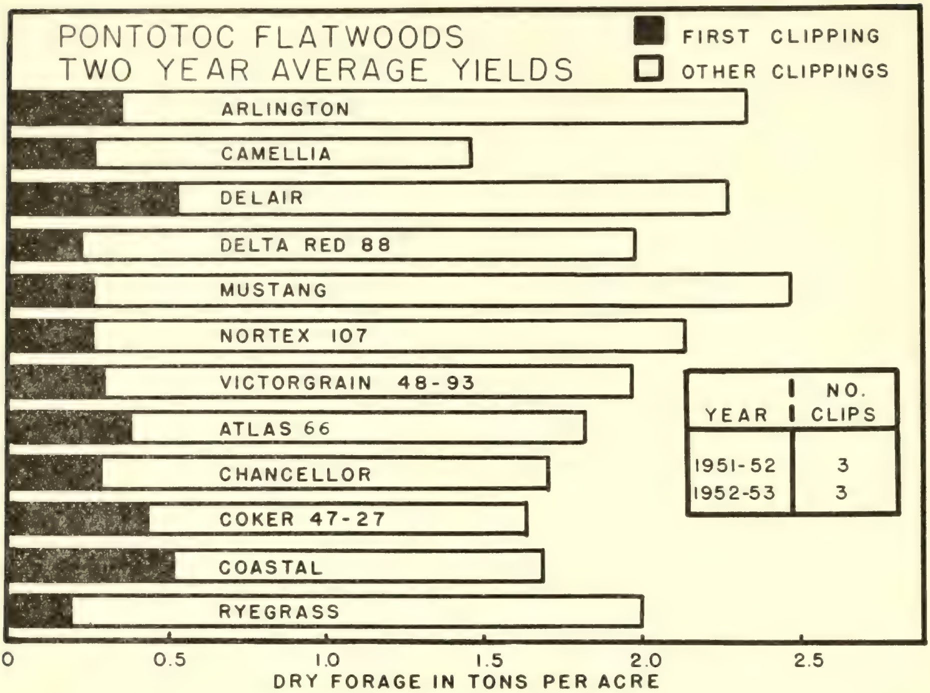
Grain yields after clipping were obtained only the first year at Holly Springs and are not recorded here.

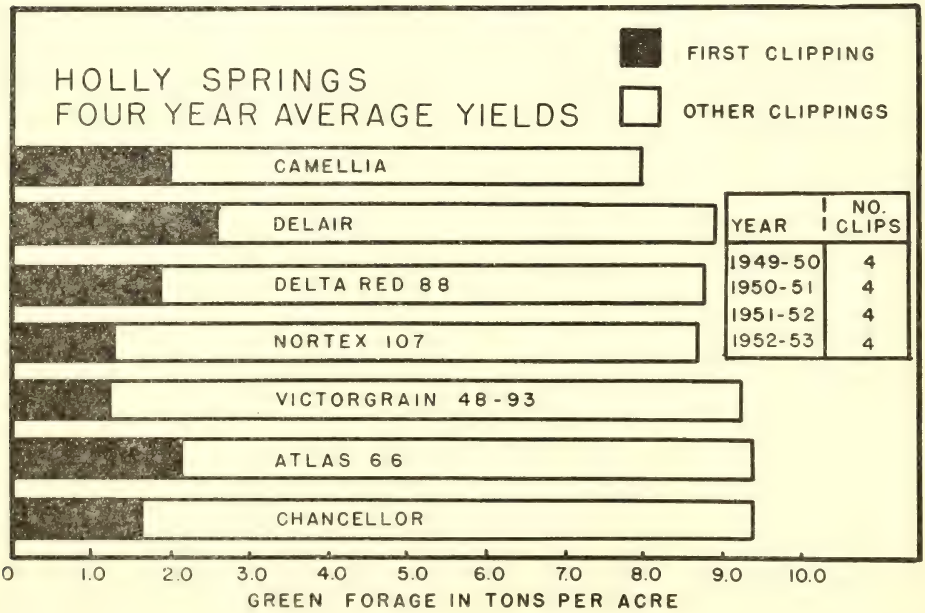
Abruzzi rye and Kenbar barley were in the test only in the fourth year. Abruzzi was fifth in early growth but eighteenth in total growth. Kenbar was lowest forage yielder.

The yields of early forage shown for ryegrass are deceptively low. In fall and winter, ryegrass has a very prostrate growth which animals can reach but which is mostly lower than a mower can cut.

Conclusions: Small grain pasture should not be grazed when the plants are jointing because stock will eat many young heads. For highest grain yields, therefore, discontinue grazing when jointing begins. Abruzzi rye seems to begin jointing before the other small grains. Barley and wheat are next and oats joint the latest, generally speaking. The result is that oats, except for the early varieties, stand late winter and spring grazing up to about April 1 better than the others. When grazing is discontinued in early or mid-February, the four small grain crops will each produce a roughly normal yield of grain when adequately fertilized.

Small grain varieties, during the vegetative stage of development, differ in habit or form of growing. Varieties like Delair and Coastal are erect. Arlington and Mustang are prostrate or reclining. Certain other varieties are intermediate between these two extremes. Chancellor is semi-prostrate


PONTOTOC FLATWOODS
TWO YEAR AVERAGE YIELDS
FIRST CLIPPING
OTHER CLIPPINGS
ARLINGTON
CAMELLIA
DELAIR
DELTA RED 88
MUSTANG
NORTEX 107
VICTORGRAIN 48-93
ATLAS 66
CHANCELLOR
COKER 47-27
COASTAL
RYEGRASS
YEAR
NO. CLIPS
1951-52 3
1952-53 3
0
0.5
1.0
1.5
2.0
2.5
DRY FORAGE IN TONS PER ACRE


HOLLY SPRINGS
FOUR YEAR AVERAGE YIELDS
FIRST CLIPPING
OTHER CLIPPINGS
CAMELLIA
DELAIR
DELTA RED 88
NORTEX 107
VICTORGRAIN 48-93
ATLAS 66
CHANCELLOR
YEAR
NO. CLIPS
1949-50 4
1950-51 4
1951-52 4
1952-53 4
0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
GREEN FORAGE IN TONS PER ACRE

while Atlas 66 and Delta Red 88 are semi-erect.

Hardiness toward cold is sometimes though not always related to habit of growth. Delair and Coastal, both erect, are less hardy than most of the intermediate or prostrate vegetating varieties. An exception to this relationship is Abruzzi rye which, though semi-erect in development, has been almost as hardy as the prostrate growing varieties of other small grain crops in Mississippi tests.

In choosing varieties to use for pasture, then, it is well to consider habit of growth. The erect varieties should be more carefully managed than decumbent types to avoid overgrazing and to prevent late grazing if grain is to be produced.

Erect varieties making an early start in the fall during favorable moisture and temperature conditions will yield more fall grazing than the more prostrate varieties. Erect varieties, however, will yield less and less as the season advances and the prostrate varieties will yield more and more. This relationship suggests use of mixtures of erect and prostrate varieties for grazing.

Tests of forage production by mixtures have been made, an example of which is erect Delair with prostrate Arlington oats. Forage yields of mixtures have been better distributed over the grazing season than have those of the erect and prostrate varieties seeded alone. The total seasons forage yield of the mixture has been intermediate between those of pure-stands of the component varieties. During a mild winter the erect component has had a higher total yield than the mixture. During a severe winter, the prostrate component has had a higher total yield than the mixture.

DISEASES AND THEIR CONTROL

Diseases are the greatest single hazard in small grain production. Increases in grain yields in recent years are due chiefly to the use of disease control measures such as seed treatment, crop rotation and principally the use of disease resistant varieties.

Oat Diseases

Leaf Rust (or crown rust) occurs throughout the state but is particularly important in South Mississippi, where temperature and high humidity favor disease development. In some years this disease has reduced grain yields to nearly zero. Heavy infection may also cause lodging and premature ripening.

Leaf rust may appear early. The leaves show small light-yellow pustules (blister-like lesions), filled with the "seeds" (spores) of the rust parasite. The spores are blown about by the wind and may infect other oats. Later, these yellow pustules turn black, looking like hard, glossy specks, many of which may run together to form tiny streaks and blotches on the leaves and leaf sheaths. In time, leaves and entire plants may die. When leaf rust comes late in the season, the damage is not nearly so great.

Control: Use rust resistant varieties such as Victorgrain 48-93, Arlington, Fulgrain, Mustang, Alamo, and some others.

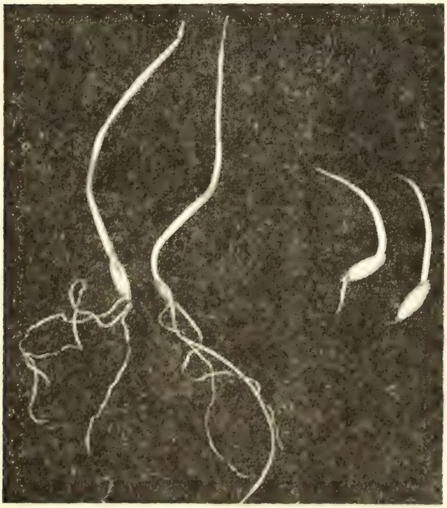
Stem rust is primarily a disease of the stem but it may also occur on leaves and other parts of the plant. It is beciming increasingly important in Mississippi. Stem rust is recognized by reddish to brown pustules which break through the plant tissue to give it a ruffled and frayed appearance, unlike the smooth appearance of the pustules of leaf rust. Later all pustules turn black.

The variety Alamo appears to have appreciable resistance to this disease.

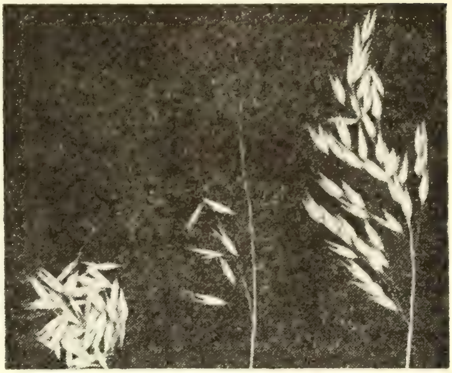
Smuts: There are two kinds of smuts well known to the farmer, loose smut and the covered smut. Both smuts destroy the part of the plant where the grain is being formed, producing a mass of dark brown to black material (spores). In the case of the covered smut this black material is covered ordinarily by a membrane which stays more or less intact. The spores of the fungus cling to the surface of the grain or they may lodge underneath the hull. When a smutted kernel is planted and begins to germinate, the smut parasite germinates too, and immediately penetrates the young plant and grows with it and inside it. By the time oats begin jointing the parasite has reached the terminal growing point and has started to destroy the flower parts, eventually smutting the heads. Both kinds of smut are spread by wind, rain, and threshing operations.

Control: Both smuts are so easily and cheaply controlled by seed treatment with fungicides that farmers need not suffer losses from oat smut of any kind. Some varieties like **Fulgrain,** Arlington, and Victorgrain 48-93 have considerable resistance to smut.

Victoria blight (Helminthosporium blight) represents a serious threat to the oat crop. It affects the root system, crown, and foliage, and may kill or seriously weaken the plants at any age. This disease is recognized by the wine-red stripes along the margins of the leaves when the plants are young, by lodging of headed plants and by darkening of the nodes due to the accumulation of black fungus spores. The roots may be destroyed completely. High temperature and rainfall aid in the development of this disease and together may reduce the stand to such an extent that reseeding may be necessary. Such losses have often occurred, particularly in South Mississippi, when farmers have made early seedings for the purpose of obtaining early grazing. Instead, grazing has actually been delayed because of the necessity of one or more replantings. Subject to this disease are many of the best yielding varieties such as Arlington, Mustang, Victorgrain 48-93, Fulgrain, Alamo, and others. The red "rustproof" oats are resistant to Victoria blight, as are Camellia and Delair.



Victoria blight destroying the root system of young plants of a susceptible variety. On the left are shown seedlings of a resistant variety.



"Spikelet Drop" of oats. Note bare spike and dropped kernels at left. At right is a healthy spike.

The organism which causes the disease is carried on the seed and also lives in the soil.

Control: Use disease resistant varieties. Treating seed with fungicides has not appreciately controlled this disease. Rotation of susceptible varieties with other crops is recommended.

Culm rot, which is related to Victoria blight, attacks many oats but particularly varieties like Southland. Seed treatment and crop rotation are the best control recommendations available at present.

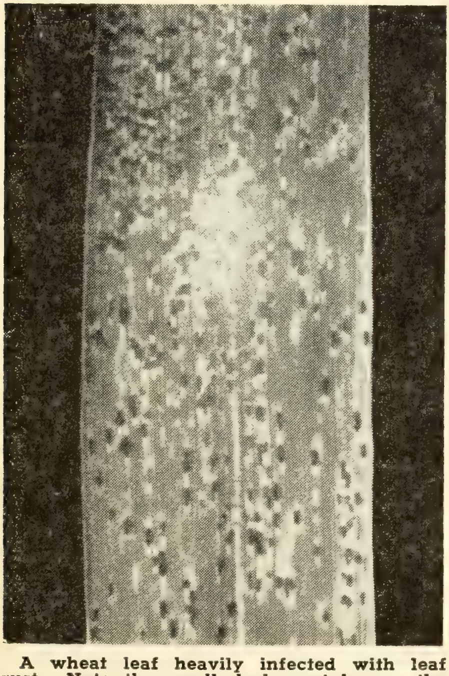
Other diseases seemingly of less importance at present are leaf blotch, anthracnose, downy mildew, and Septoria black stem, all caused by fungi; halo blight caused by bacteria; and "red leaf" and several kinds of mosaics, caused by viruses. (Reddening of leaves may also be caused by malnutrition, insects, and other causes.)

Spikelet drop, a new disease of unknown origin which has recently appeared on oats in a few fields in Mississippi, consists of shedding of kernels just before or at harvest time. Control measures have not yet been developed.

Wheat Diseases

Leaf rust is the most widespread wheat disease of importance in the South and though presently controlled by resistant varieties, is potentially very important. Older varieties like Hardired and Sanford were fully susceptible. Many instances of poor performance of older wheat strains in past years were due to leaf rust infection. The symptoms closely resemble those of leaf rust of oats previously described.

Control: Use resistant varieties such as Anderson, Coker 47-27 and Atlas 66.



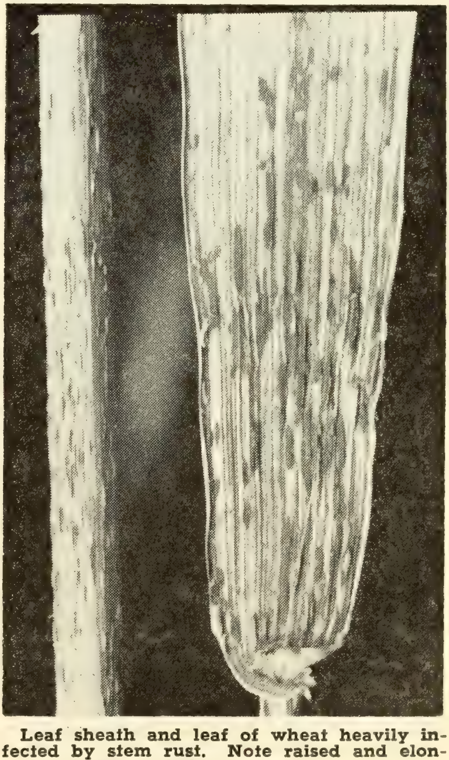
A wheat leaf heavily infected with leaf rust. Note the small dark pustules on the leaf.

Stem rust of wheat closely resembles stem rust of oats previously described. Varieties currently recommended have fair resistance.

Loose smut is common in Mississippi wheat fields although it has only occasionally been severe enough to lower grain yields. Symptoms are similar to those of loose smut of oats.

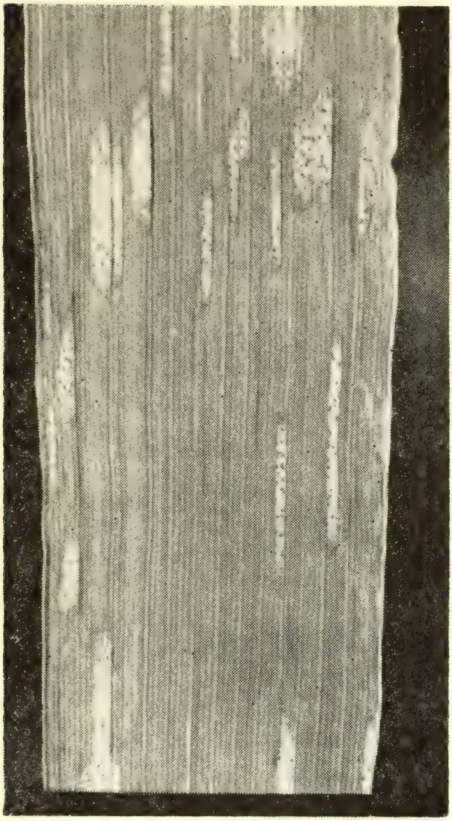
The loose smut fungus is wind borne and infection results from spores being blown by the wind into open florets on normal heads. Infection of the developing seed follows. The fungus remains alive inside the seed during dormancy and smuts the heads of the plant that develops the next season from the infected seed.

Control: Hot water treatment is the most effective method of control but it is laborious and exacting. Anderson is the only wheat recommended that shows moderate resistance to this dis-



Leaf sheath and leaf of wheat heavily infected by stem rust. Note raised and elongated pustules of the disease.

ease. Certified seed, free from the disease, may be obtained. Seed protectants and disinfectants are not effective in control of loose smut of wheat and barley.



Leaf blotch lesions on wheat. Note the light colored elongated speckled lesions on the leaf.

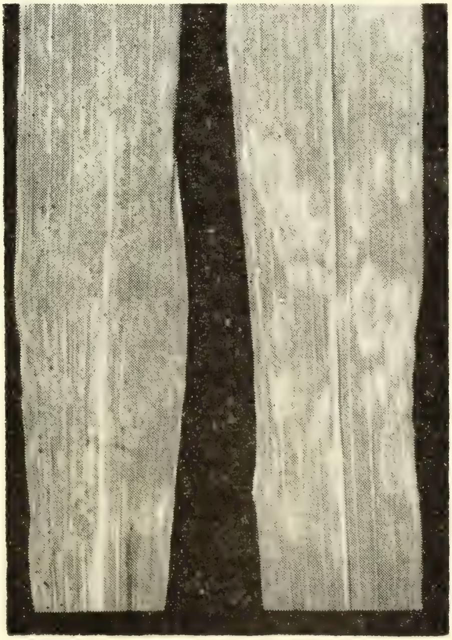
Septoria leaf blotch and glume blotch. Leaf and glume blotch are common in Mississippi though of only slight importance so far. Leaf blotch appears to be the more important of the two though both diseases may be severe on unadapted varieties. Leaf blotch appears on the leaves as pale brown lesions sometimes rather boat shaped and sometimes elongated. Many tiny black fruiting bodies develop on these lesions and are mainly responsible for perpetuating the fungus from season to season.

Glume blotch appears on the heads and nodes of the stems as brown lesions spotted with small black bodies. Septoria may infect seeds and be thereby transmitted to the next crop.

Some of the recommended varieties such as Anderson have good resistance though none are free of the disease. Crop rotation, plowing under of wheat crop refuse, and destruction of volunteer wheat plants are control measures. Seed treatment with a mercurial compound will kill the fungus in or on the grain.

Powdery mildew is common on wheat though unimportant except when soil fertility is high enough to encourage vigorous plant growth. The disease is most prevalent on leaves and leaf sheaths in late winter and early spring during periods of cool, cloudy weather. Heavy infection destroys leaves, reduces palatability of the foliage, and reduces grain yields.

The disease consists of whitish patches of various sizes mostly on lower leaves and leaf sheaths. Small,



Powdery mildew on wheat leaves. Note the white growths often with black specks in them on the leaves.

black fruiting bodies later develop in the whitish fungal growths and are responsible for the organism living over the dry summer months.

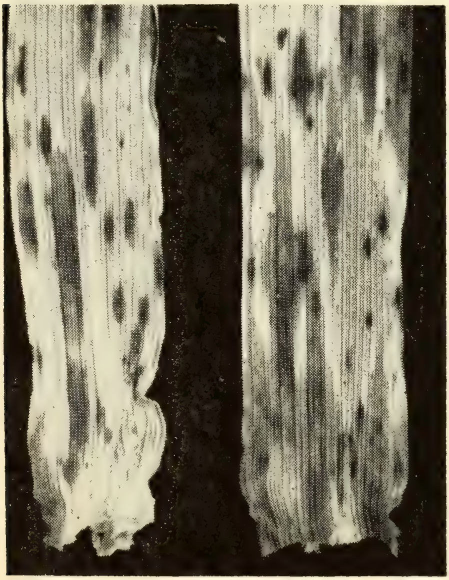
None of the recommended wheats for Mississippi is fully resistant to this disease though Anderson has some resistance.

Dieases of wheat reported in Mississippi but which occur less commonly than those previously discussed are take-all, anthracnose, basal glume rot, scab, and downy mildew.

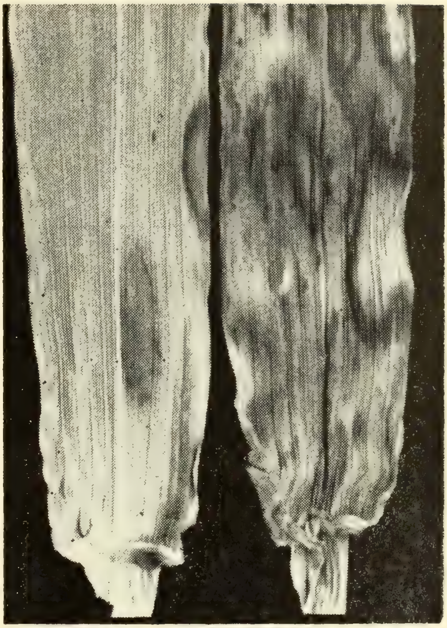
Barley Diseases

Blotch is common on barley in Mississippi and is potentially a serious disease in commercial fields. It is most apparent on the leaves but may attack roots, crowns, heads and seeds. Leaf symptoms consist of elongate, often rectangular, dark brown lesions usually darker in the middle where the fungus is most abundant. The fungus lives in the soil and also may survive from season to season in crop refuse and infected seeds. Infected seeds may be darkened.

Seed treatment with a mercurial is partly effective in controlling seedling infection. Crop rotation and disposal of infected crop refuse is helpful. No recommended commercial variety is resistant to this disease.



Barley leaves showing typical net blotch lesions. Note the dark, often elongate lesions.



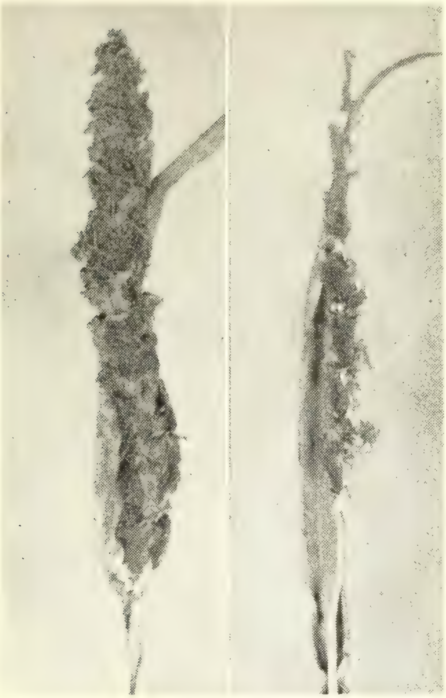
Barley leaves affected by scald. Note the sometimes oval, dark discolorations where the disease has developed.

Powdery mildew is similar to powdery mildew of wheat. Kenbar is highly resistant.

Scald is recognized by the regular water soaked lesions with dark margins that develop on leaves and leaf sheaths. Disease development is favored by cool weather. The fungus lives over the summer in crop residue. Resistant varieties, of which Kenbar is an example, offer the most effective control measure.

Leaf rust usually occurs too late in the spring to damage barley in Mississippi except in the most southern counties. It is similar in appearance and nature to leaf rust of wheat already described. No recommended variety is fully resistant to this disease.

Stem rust. Stem rust is usually uncommon because barley escapes by early maturity. The disease has the same appearance as on wheat.



Loose smut affecting Kenbar barley. Note the black spore masses that have developed instead of seeds and chaff.

The recommended variety, Kenbar, is not resistant to stem rust.

Smuts (covered smut, "Nigra" and "Nuda" loose smut) can be severe on barley and have been reported to have damaged some fields in Mississippi. The diseases have the same appearance as smuts on wheat. Smut and "Nigra" loose smut are controlled by chemical seed treatments. "Nuda" loose smut is controlled by hot water treatment.

Kenbar is partially resistant to "Nuda" loose smut. Use of seed is recommended from fields grown from hot water treated seed or other fields observed to be free of smut.

Parasitic diseases of barley in Mississippi that have been reported but which are not yet serious are virus yellows and stripe.

Barley grown on soil having a pH in the very acid range, that is less than 5.0, will be yellow and stunted. Liming of the soil to bring the pH up toward neutrality will permit barley to make normal growth.

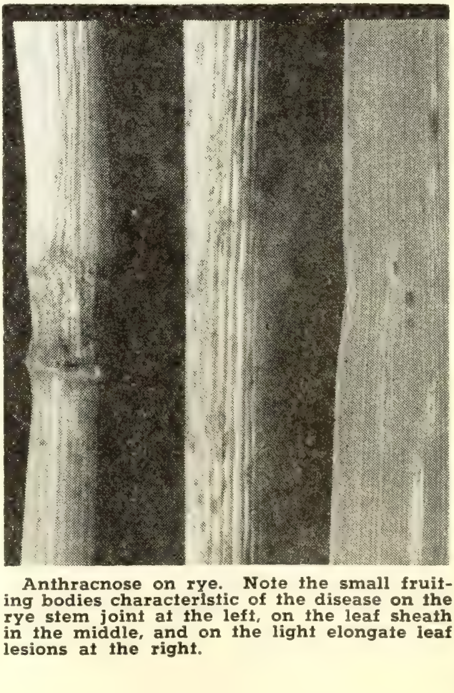
Yellowing of barley is usually the result of insufficient nutrients and may sometimes be due to poor drainage.

Rye Diseases

Leaf rust is common every year though not always abundant enough to be damaging. It is more prevalent in the springs in the southern counties than elsewhere and causes premature dying of leaves and shriveling of grain. It is the same in appearance as leaf rust of other small grain.

Stem rust on rye is similar to that of wheat previously described. In Mississippi it has not been observed to be common.

Anthrocnose has been common and damaging. The disease appears on the leaves and stems as elongate, narrow lesions, light brown in color and often with tiny black dots on the surface. Similar lesions occur on the leaf sheaths. Anthracnose is most common under conditions of low fertility. The fungus lives in the soil on crop residue.



Anthracnose on rye. Note the small fruiting bodies characteristic of the disease on the rye stem joint at the left, on the leaf sheath in the middle, and on the light elongate leaf lesions at the right.

Proper fertilization of rye, rotation with legumes, and plowing under of infested crop residue are useful control measures.

Minor parasitic diseases of rye in Mississippi are scald, mildew, and bacterial blight.

Seed Treatment

It is recommended that all small grain seed be treated with a suitable fungicide before seeding. Ceresan M and Panogen are generally recommended. Ceresan M is used as a dust or slurry at the rate of ½ oz. per bushel, while Panogen, a liquid, is applied at the rate of ¾ oz. per bushel of grain.

The practice of seed treatment is recommended because it enables the young plants to make a good start, producing thicker stands of healthy plants, and it controls certain diseases. Increased stands do not always mean more grain, but where weed competition is a factor, extra plants shade weeds and limit their growth.

A few shrivelled and discolored kernels in a handful of seed may indicate an unhealthy condition. Germination tests of representative samples are made for farmers by the State Seed Laboratory at State College. These tests generally indicate the health status of a particular sample. (They do not show, however, smut infested kernels.) At times, it is difficult to determine to what extent a seed lot may be diseased and with what kind of parasites. On the other hand, a seed sample may appear very healthy and show a high percentage of germination and yet harbor certain parasites in large numbers resulting in poor stands in the field. The application of the proper fungicide will often help disinfect the seed of many important parasites and, in addition, protect it during germination.

Chemical seed treatment will control completely or partially the following diseases:

On oats: Loose and covered smuts (complete); Halo blight, Helminthosporium blights (partial).

On wheat: Black chaff, bacterial glume rot, scab, crown rot (partial); bunt (partial to complete).

On barley: Covered smut, nigra loose smut, stripe (complete); bacterial blight, net and spot blotch, scab (partial).

On rye: Stalk smut (partial to complete).

Chemical seed treatment has no effect on rusts, mildews, mosaics, and others. Certain diseases like loose smut of barley and wheat are controlled by treating the seed with hot water, since chemical treatment is not effective. The hot water treatment is troublesome and very exacting and consequently not too practical for large amounts of seed to be treated on the farm. Besides, this treatment does not protect the seed against disease-causing organisms that are found in the soil as do the chemical treatments.

There are several methods of applying Ceresan M, Panogen and other fungicides for small grains. When the treatment is done at home with relatively small quantities of seed, a barrel mounted on an eccentric axle may be used. Thorough mixing, particularly with Panogen, is essential. Portable treating-cleaning outfits are used in some places. They employ mostly dust fungicides. Seed treated with mercurials should be allowed to stand at least 24 hours before planting.

Seed treating plants are available. These plants generally clean and treat seed on a custom basis. They use dust, slurry or liquids. In Mississippi, seed oats and some other small grains are frequently sold already treated.

Seed treatment will gain the farmer on the average about two to three bushels of grain per acre per year, though in some years the increase may not be noticeable. In other years it may be up to 10 bushels per acre.

The following warnings are given about all seed treatments. Seed treatment is low cost insurance but is not a cure-all. It is not a substitute for good quality seed. Certain diseases cannot be controlled through seed treatment.

WEED CONTROL

Several species of broadleaf weeds occurring in fields of small grain may be controlled safely with timely treatments of 2, 4-D or 2, 4, 5-T.

Dock (Rumex crispus L.) may be controlled with 2, 4-D in the early spring before the dock stems elongate and when the weed is growing vigorously. During periods of retarded growth or as the plant nears maturity, the 2, 4-D will not give satisfactory control. Because the herbicide is most effective during warm, sunny weather, application should be made during such a period.

Small grains sprayed with 2,4-D for dock control should be well tillered at time of treatment but applications should not be made after the cereal stems have elongated. The two most susceptible periods in the growth of small grains are (1) beginning when the grain comes up and ending after tillering (about when the fifth leaf is expanded), and (2) from the boot stage to the time when heading is completed. The 2, 4-D should not be applied during these periods. In most seasons the period between February 15 to March 15 could be considered a safe time to treat cereals with 2, 4-D for dock control. The amine form of 2, 4-D should be applied at a rate of ¾ to 1 pound active material per acre. Ten to 20 gallons of water containing the 2, 4-D will give adequate spray coverage for one acre with ground equipment. Good success has been obtained also from aerial applications at lower volumes.

A single application of 2, 4-D made properly usually gives a high percentage control of growing dock but infested fields have numerous dormant seeds in the soil and treatments over a period of several years may be required to eradicate the dock. White or Ladino clover seedlings in cereals may be damaged severely by sprays of 2, 4-D but established clovers are injured very little by the compound. It is safe to graze cereals sprayed with 2, 4-D.

Vetch (Vicia spp). and Wild Winter Peas (Pisum sativum var. arvense L.) sometimes occur as weeds in small grains. These may be controlled with 2, 4-D applied in the manner and at the same rates described for dock. The amine salt of the herbicide 2, 4, 5-T gives better control of these species than 2, 4-D but is more injurious to legumes and also will not control dock as well as 2, 4-D.

Wild Onion (Allium canadense L.) growing in cereals may be partially controlled by a spray application of an ester formulation of 2, 4-D at a rate of 1 to 1½ pounds per acre acid equivalent. The treatment may prevent seed production of a large proportion of the onions but the compound will not eradicate wild onion. The ester formulations of 2, 4-D are considerably more damaging to small grains and legumes than the amine formulation. Because onions are so difficult to wet with amine 2, 4-D sprays the ester formulations are preferred. Treatment should be made when a large percentage of the onion bulbs have sprouted.

The herbicide maleic hydrazide (MH) has shown promise for controlling wild onion but it cannot be applied to growing small grains under any circumstances. Maleic hydrazide can be employed, however in reducing wild onion populations as a clean-up measure during the winter or early spring. Farmers desiring to produce certified seed may find it economical to spray wild onions with MH in old corn or cotton fields preparatory to seeding cereals the next fall.

The MH should be applied at a rate of 3 pounds active ingredient per acre in 20 gallons of water when a high percent of the bulbs have shoots above the ground. The percentage of bulbs sprouted may be determined by digging up several clumps of onions and examining them for unsprouted bulbs. Unsprouted bulbs are not controlled by the spray and these will produce onion plants in the subsequently sown grain. A good wetting agent should be added to the MH spray solution at a concentration of about 0.05% in order to insure good wetting of the onions.

INSECT CONTROL

There are several species of insects which attack small grains in the field at various stages of development. The most serious pests often infest a crop and ruin it before the farmer realizes that there is any trouble. Adequate controls for these insects have been developed, but it is necessary that they be applied before serious damage has resulted.

There are two kinds of insects that frequently attack small grains before they are large enough for grazing. In this stage of plant development serious insect damage can reduce the stand below a profitable level in a very short time. These insects are the greenbug[1] and the fall armyworn.[2]

The **greenbug,** which is an aphid or plant louse, is a pale-green, soft-bodied insect which feeds by sucking plant juices. The young are born in an active stage. The life cycle is very short, and in from one to two weeks the young may mature and themselves be giving birth to others. As a result, large populations may be built up very quickly. Some of them usually have wings, and when the food supply is poor most of them develop wings and fly to other plants. The leaf area where feeding has taken place becomes yellow and dead, and where large numbers feed the leaf soon dies. Heavy infestations may kill small plants and spots of dead plants may show up in the fields.

The greenbug may desert small grains in the summer and pass the hot months in small numbers on some of our common grasses. They have been found on crab grass in late summer, and early fall. Flights to small grains usually take place about the first of October. There seem to be more greenbugs in early planted small grains following years of abundant summer rains.

Experiments have shown that plants in vigorous growing condition are best able to survive greenbug attacks. This seems to be due to the rapid production of healthy leaf tissue, which reduces the percentage of leaf loss by the plants. A good rate of a nitrogenous fertilizer as recommended for the crop is more profitable than poison application on poor plants, but after a heavy population has built up fertilization would be too slow to save the plants without poisoning to kill the insects.

Control: At temperatures above 50° F. good control of greenbugs can be obtained by dusting with 3 percent gamma benzene hexachloride or 3-5-0 cotton dust at the rate of 10 to 15 pounds per acre. At lower temperatures 1 percent parathion dust at 10 pounds per acre gives better control. Parathion is a very hazardous insecticide and the directions on the label should be followed carefully. No grazing should be allowed for at least two weeks after these poisons have been applied.

Fall armyworms are the larvae or young of a moth which deposits its egg in masses on green plants. They feed on a number of host plants and may migrate into small grains, but usually the eggs are deposited on the small grains after they are up large enough to see. The young worms are very small and difficult to see, and they often hide around the base of the plants. Therefore infestations may be easily overlooked, but in the early feeding, the larvae leave a layer of the leaf on the tip or edge, and this turns white. For this reason a field or spot in a field, heavily infested with young larvae has a frosty look when examined closely. Unless the worms are controlled a heavy infestation will soon ruin a stand.

The fall armyworm moths, which are about an inch long, are dark gray with dark mottling on the wings. The larvae or worms vary in color from tan to green, and the larger ones have three light colored fine lines down the back and a dark line on the side above a yellow stripe, which is splotched with red. There is an inverted Y on the front of the head. When the larvae mature they burrow in the soil to pupate. There are several generations in a year in the South, and usually by fall when the small grains are young the moth population builds up to damaging proportions.

As the larvae mature they eat more; the ground is soon bare and the larvae then migrate to new feeding areas. In this manner, they may sweep across a field, and because of this habit they are called armyworms.

---

[1] **Toxoptera graminum** Rondani.

[2] Laphygma frugiperda (Smith and Abbot), also called the southern grass worm.

Control: Young larvae of the fall armyworm may be controlled with 10 to 15 pounds per acre of either 5% DDT, or 20 percent toxaphene dust, or spray containing DDT to give 1 pound per acre, or toxaphene to give 2 pounds per acre of the active material. After the larvae reach a length of approximately ¾-inch they are more difficult to control and may require larger dosage. No grazing should be allowed for at least two weeks after poisoning.

Other Insects on Small Grains for Grazing

In the fall of the year one may notice large numbers of leafhoppers and flies in the small grain fields. It is not known what damage these insects do, and to date, experiments do not indicate that they do measurable damage.

Insects Attacking Small Grains Harvested for Grain

Armyworms[3] and cutworms often cause damage to small grains in the spring, particularly in the Delta section of Mississippi. These insects are mentioned together since they are often found in a mixed population, and when this mixture is present it is necessary to use more poison because the cutworms are harder to kill.

The true armyworm looks very much like the fall armyworm, but the former do not have the inverted Y on the head. The armyworm moth is a brownish-gray color with a small light dot on each wing. There may be several generations of the armyworm in a year, but the serious damage to small grains is usually noticed in March or April when the larvae are about one-half inch long. Both armyworms and cutworms may migrate into grain fields from pastures or sod areas nearby. Late in the season the grain heads may be seriously damaged by heavy infestations. Careful examination of the field and nearby sod areas may allow treating before serious damage has occurred or before the insects enter the field. This is important also to avoid poison residue on the grain when it is harvested.

Control: When armyworms are found without cutworms, they may be controlled with sprays applied at the rate of 2 pounds of toxaphene or 0.2 of a pound of dieldrin per acre, or by dusts of 20 percent toxaphene at the rate of 15 pounds per acre or 1.5 percent at the rate of 7 to 10 pounds per acre.

When cutworms are found mixed with armyworms, both may be killed by sprays applied at the rate of 3 pounds of toxaphene or .3 pounds of dieldrin per acre, or by dusts of 20 percent toxaphene at the rate of 15 pounds per acre of 1.5 percent dieldrin at the rate of 20 pounds per acre. Cutworms alone also may be killed with DDT spray applied at the rate of 1 pound per acre or 10 percent at the rate of 10 pounds per acre.

The **English grain aphid**[4] is sometimes found in the heads of maturing small grains, but to date there is no record of this insect doing major damage in Mississippi. Ten aphids per head is considered a very light infestation. The reproduction is much like that of the greenbug, but the adult females over-winter in the clumps of small grain and in the spring they infest the heads as they are maturing. The English grain aphid is a pale greenish color with dark antennae and dark markings. Heavy infestations may cause light or shriveled grains at harvest. Poisoning would present a serious poison residue problem on the grain, however, due to the late time of infestation.

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[3] **Pseudaletia unipuncta** Haworth.

[4] **Macrosiphum granarium.**

APPENDIX

Table 1. Forage yields by years of Delta Red 88 oats fertilized with different rates of nitrogen, phosphate and potash on Grenada silt loam, North Mississippi Branch Station, 1948-1954.

Pounds per acre		Pounds of oven-dry forage per acre						
Fall N-P_2O_5-K_2O	Spring N	’48-’49	’49-’50	’50-’51	’51-’52	’52-’53	’53-’54	Average
				First clipping				
0-0-0	0	183	0	12	72	13	10	48
0-60-0	0	292	74	27	117	0	48	93
0-120-0	0	395	107	44	104	42	144	139
30-0-0	0	196	32	64	142	61	41	89
30-60-0	0	490	334	132	172	278	366	295
30-120-0	0	700	767	130	183	338	531	432
45-0-0	0	205	37	104	104	137	101	97
45-60-0	0	681	437	160	223	698	836	506
45-120-0	0	1059	897	147	210	742	968	670
60-0-0	0	220	34	83	100	160	95	115
60-60-0	0	893	549	162	161	918	1228	652
60-120-0	0	1204	853	163	198	1025	1695	856
60-0-50	0	240	40	84	180	148	667	226
60-60-50	0	825	668	167	302	968	1367	716
60-120-50	0	1285	961	172	303	1066	1418	867
Clipping date		11-1	11-9	3-17	3-7	3-6	3-26	
				All clippings				
0-0-0	0	474	490	418	627	766	1017	632
0-60-0	0	575	604	441	849	670	906	674
0-120-0	0	707	620	491	840	1140	1562	893
30-0-0	30	567	1739	1687	1973	2295	1883	1691
30-60-0	30	838	1642	2056	1966	2561	2541	1934
30-120-0	30	1080	1776	1802	2017	2877	2590	2024
45-0-0	45	620	2310	2184	2269	3297	2941	2270
45-60-0	45	1126	2265	2388	2674	3984	3615	2675
45-120-0	45	1364	2425	2433	2621	4314	3659	2803
60-0-0	60	723	2562	2515	2652	3534	2818	2467
60-60-0	60	1216	2865	2826	3176	4819	4684	3264
60-120-0	60	1527	2593	2777	3239	4830	4744	3285
60-0-50	60	772	2568	2106	2840	3495	3930	2618
60-60-50	60	1234	2790	2907	3366	4779	4655	3288
60-120-50	60	1686	3032	2923	3439	5013	4666	3460

Table 2. Forage yields by years of Delta Red 88 oats fertilized with different rates of nitrogen, phosphate and potash on Prentiss fine sandy loam, Coastal Plain Branch Station, 1948-1952.

Pounds per acre		Yield in pounds of oven-dry forage per acre									
		First clipping					All clippings				
Fall N-P_2O_5-K_2O	Spring N	’48-’49	’49-’50	’50-’51	’51-’52	Ave.	’48-’49	’49-’50	’50-’51	’51-’52	Ave.
0-0-0	0	180	182	88	132	145	488	351	425	488	438
0-60-0	0	185	227	150	182	186	470	404	488	500	465
0-120-0	0	209	282	150	280	230	523	486	487	628	531
30-0-0	30	457	391	150	125	281	1317	1376	1637	1063	1348
30-60-0	30	515	665	370	381	483	1346	1714	2029	1810	1724
30-120-0	30	660	723	449	331	541	1547	1999	2111	1805	1865
45-0-0	45	531	393	123	107	288	1629	1526	1854	1015	1506
45-60-0	45	993	829	431	409	665	2239	2224	2599	2241	2326
45-120-0	45	1019	1032	489	410	737	2313	2656	2634	2082	2421
60-0-0	60	570	414	81	59	281	1790	1718	1908	1691	1777
60-60-0	60	1199	913	334	377	706	2608	2637	2966	2159	2592
60-120-0	60	1338	1193	546	465	885	2701	3036	3100	2377	2803
60-0-50	60	639	510	106	95	337	1893	2020	2300	1850	2016
60-60-50	60	1233	1354	475	639	925	2724	3585	3430	3009	3187
60-120-50	60	1365	1544	942	754	1151	2954	3778	3798	2880	3352
Clipping date		10-25	10-20	11-14	1-1						

Table 3. Forage yields by years of Delta Red 88 oats fertilized with different rates of nitrogen, phosphate and potash on Grenada silt loam, North Mississippi Branch Station, 1948-1954.

Pounds per acre		Yield in pounds of oven-dry forage per acre						
Fall	Spring	Fall or first clipping						5-year all clippings ave.*
$N-P_2O_5-K_2O$	N	'48-'49	'49-'50	'50-'51	'51-'52	'52-'53	Ave.	'48-'49, '51-'53
0-0-0	0	770	350	152	250	13	307	1958
0-60-0	0	1038	694	213	634	161	548	2059
0-120-0	0	1310	809	241	935	215	702	2245
30-0-0	30	1576	408	191	142	20	467	3150
30-60-0	30	2008	903	335	717	420	877	3528
30-120-0	30	2383	1111	526	977	715	1142	3521
45-0-0	45	1811	373	234	147	28	519	3362
45-60-0	45	2750	949	505	698	515	1083	3988
45-120-0	45	3046	1168	629	857	1042	1348	4352
60-0-0	60	1885	350	309	283	16	569	3920
60-60-0	60	2787	1004	599	734	561	1137	4475
60-120-0	60	2961	1325	700	803	1105	1379	4840
60-0-50	60	1835	378	337	229	30	562	3771
60-60-50	60	3032	1007	683	868	726	1263	4734
60-120-50	60	3421	1350	881	975	1170	1559	4970
Date of clipping		10-29 1-11	11-8	3-22	1-7	1-28	2-12	

*Grain yields were obtained on other years.

Table 4. Forage yields by years of Delta Red 88 oats fertilized with different rates of nitrogen, phosphate and potash on Prentiss fine sandy loam, Coastal Plain Branch Station, 1953-1954.

Pounds per acre	Pounds of oven-dry forage per acre		
$N-P_2O_5-K_2O$	1952-53	1953-54	Average
0-0-0	1318	1479	1398
90-0-0	2689	3354	3021
90-60-0	2829	3104	2966
90-90-0	2756	3256	3006
90-90-30	3104	3478	3291
90-90-60	3270	3382	3326
135-0-0	2863	3354	3108
135-60-0	3043	3513	3277
135-90-0	3263	3522	3392
135-120-0	3199	4106	3652
135-120-30	3678	4273	3975
135-120-60	3721	4454	4087
180-0-0	3344	3822	3583
180-60-0	3441	3877	3659
180-90-0	3530	4164	3847
180-120-0	3621	4334	3977
180-120-30	3581	4404	3992
180-120-60	3894	4929	4411

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Labor, Power, and Equipment For

Harvesting Feed And Forage Crops

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

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Summary and Conclusions

This study was made to determine labor requirements for harvesting different feed and forage crops and the cost of operation for specialized harvesting equipment.

Farms in Lowndes, Monroe, DeSoto, Tate and Panola counties having several items of feed and forage harvesting equipment were selected for study. Information was secured from operators of these farms regarding their experience relative to costs of operation, labor requirements, extent of use, etc., for different items of feed and forage harvesting equipment. In addition, information was obtained on costs associated with feed processing equipment and buildings used for storing feed and forage crops, custom charges for haresting feed and forage crops, and labor requirements for feeding the crops.

Results of this study indicate that:

(1) Labor requirements for harvesting corn by hand can be reduced substantially by throwing the pulled corn directly into the wagon, trailer, or trucks instead of into a heaprow.

(2) Labor requirements for harvesting silage material can be reduced considerably by use of field forage harvesters, especially if a trench silo is used for storage.

(3) Due to the relatively high fixed cost as compared to variable cost for most of the items of feed and forage harvesting equipment, more use each year would offer possibilities for reducing per unit costs of operation.

Because of high fixed costs, many operators of small farms cannot profitably buy expensive specialized harvesting equipment for use on only a few acres, even though a dependable supply of farm labor is not available. For this group of farmers two possibilities are open:

(1) Buy specialized harvesting equipment with the intention of doing work for others on a custom basis to help defray at least a part of the fixed cost.

(2) Make arrangements with owners of the required harvesting equipment to do work on his farm on a custom basis.

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LABOR, POWER, EQUIPMENT REQUIREMENTS, AND EQUIPMENT COSTS FOR HARVESTING FEED AND FORAGE

By THOMAS E. TRAMEL and DAVID W. PARVIN

Labor shortages, production restrictions on cotton, and relatively high prices for livestock products have caused Mississippi farmers to shift toward a livestock economy. As late as 1950 the U. S. Census reported only 1,569,327 head of cattle and calves on Mississippi farms. By 1954 the same report shows an increase to 2,319,590 head, or an increase of 48 percent. As to whether this trend will continue only time will tell. But possibilities of tighter production controls on cotton and continued high levels of employment in industry make it seem quite likely.

An increase in livestock numbers requires additional feed and forage production. Moreover, this additional feed and forage must be obtained at a cost which permits a profit to be realized from livestock on individual farms. In view of the shortage of farm labor, mechanization of production, harvesting, and feeding of feed and forage crops seems desirable. Generally, the same equipment used in the production of other crops may be used in the production of feed and forage crops. On the other hand, harvesting equipment is generally specialized.

The purpose of this study was to determine labor and power requirements and cost of operation for some of the more specialized items of equipment required in harvesting feed and forage crops. In addition, cost of processing equipment, cost of storage facilities, and labor requirements for feeding different types of feed and forage crops are presented.

Method of Study

To meet the objectives of study, areas of the state were selected where a large number of the items of specialized equipment could be found. Within these areas, county Extension agents and other agricultural workers helped select farmers who operated several of the items of specialized equipment. These farmers were then interviewed and the figures presented in this report are the result of their experiences regarding costs, extent of use, labor requirements, etc. A total of 304 farmers in Lowndes, Monroe, DeSoto, Tate, and Panola Counties were interviewed in this study.

Description of Farms Studied

Size. Size of the farms included in this study averaged much larger than size of all farms operated by white owners in the respective counties, 796 acres, compared to 137 acres.[1] Of the total land operated, about four-fifths was owned and one-fifth rented.

Land Use. Almost one-half (45 percent) of all the total land area of the farms studied was used for crops. Another 31.8 percent was used as open permanent pasture. The remainder was accounted for by woodland pasture (14.8 percent) and other uses (8.4 percent).

Table 1. Average size of farm and land use, 304 farms, North Mississippi, 1954

Item	Acres per farm	Percent of total
Size of farm operated:		
Owned	625*	78.5
Rented in	171	21.5
Total operated	796	100.0
Land use:		
Crop land	358	45.0
Open permanent pasture	253	31.8
Woodland pasture	118	14.8
Other	67	8.4
Total operated	796	100.0

*An average of 18 acres per farm was owned and rented out in addition.

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[1] Census of Agriculture, 1950.

Feed and Forage Production Pattern. Different combinations of corn, oats, hay and silage were grown on all farms studied. Corn acreage averaged 58 on farms growing corn and oat acreage averaged 49 on farms growing oats. Hay and silage acreages averaged 99 and 32, respectively, on farms where these crops were grown. Of the 147 farms growing oats, 63 grazed oats before harvesting while 84 did not.

Considerable year-to-year variation in yields for each of the feed and forage crops was reported by the farmers interviewed. An average of the highest yields reported for the past several years was from twice as high to almost four times as high as the average of the lowest reported yield for the same period. Normal yields were 41 bushels for corn, 47 bushels for oats, 1.65 tons for hay and 12 tons for silage, primarily corn.

Labor, Power and Equipment

Harvesting Corn

Pulling corn by hand was the predominant method of harvesting on the farms studied. This method was used on 163 of the 230 farms where corn harvesting information was obtained. (Table 3). Corn was thrown into heaprows as it was pulled and then hauled later in 128 cases out of the 163. Data indicates that considerable labor saving can be effected by omitting the heaprow. Where corn was pulled and thrown into a heaprow, 12.6 hours of harvest labor were required per acre compared to from 6.5 to 9.7 hours where the heaprow was omitted.

Machine harvesting of corn was performed on 67 farms. These farms in general had larger acreages of corn than those using hand methods, an average of 94 acres compared to 43. Man labor requirements were 2.8 hours per acre where a 2-row picker was used and from 3.9 to 4.2 hours per acre with a 1-row picker. It should be pointed out that, compared to hand methods, savings in man labor by using pickers would be greater with higher yields. Man labor requirements for operating the picker itself would be essentially the same with much higher yields.

Harvesting Oats

Combining oats required from .5 to 2.2 hours of man labor and from .5 to 1.1 hours of combine time per acre, depending upon the type and size of combine used, (Table 4). Large self-propelled combines equipped with bins required only .5 hours of man labor per acre. Some of the pull-type combines were also equipped with bins.

Hauling oats required from 1.0 to 1.6 hours of labor per acre. Use of pick-up trucks for hauling resulted in the higher figure and use of 1½ ton trucks resulted in the lower figure.

Harvesting Hay

The hay harvesting operation may be conveniently divided into mowing, raking, baling, and hauling.

Mowing. The 6-ft. and 7-ft. tractor

Table 2. Acreages and yield per acre for selected feed and forage crops, 304 farms, North Mississippi, 1954.

Crop	No. farms	Acres per farm	Yield per acre			
			Unit	Normal	Highest	Lowest
Corn	238	58	Bu.	41	66	19
Oats, all	147	49	Bu.	47	67	30
Oats, grazed[1]	63	50	Bu.	46	66	30
Oats, not grazed	84	48	Bu.	48	67	30
Hay	256	99	Ton	1.65	2.48	.90
Silage crops	107	32	Ton	12	17	8

[1] An average of 831 cattle hours of grazing was secured per acre—mostly during December 15 to March 15; this is the equivalent of about 1 cow per acre for 9 hours per day during this period.

Table 3. Labor, power, and equipment requirements for harvesting corn, by type of power and size of equipment, North Mississippi, 1954.

Operation	No. farms	Acres corn per farm	Yield per acre (bu.)	Hours per acre Man	Tractor	Truck	Mule	Trailer or wagon	Picker
Harvested by hand:	163	43	39	----	----	----	----	----	----
Pulling and hauling (heaprow)[1]:	128	44	39	----	----	----	----	----	----
Mules and wagon	43	43	39	12.6	----		4.2	2.1	----
Tractor and trailer	66	41	40	12.6	1.7	----	----	1.7	----
1½ ton truck	19	55	38	12.6	----	1.5	----	----	----
Pulling and hauling (no heaprow):	35	41	38	----	----	----	----	----	----
Mules and wagon	18	53	34	9.7	----	----	5.4	2.7	----
Tractor and trailer	13	27	42	8.2	2.1		----	2.1	----
1½ ton truck	4	36	40	6.5	----	1.5	----	----	----
Harvested by machine:	67	94	46	----	----	----	----	----	----
One-row picker, hauled with tractor	46	83	46	4.2	2.9	----	----	2.2	1.4
One-row picker, hauled with truck	4	50	55	3.9	1.3	1.6	----	----	1.3
Two-row picker. hauled with tractor	17	133	44	2.8	1.7	----	----	1.4	.7

[1] Labor requirements for pulling only when thrown into heaprow were 7.7 man hours per acre based on 124 farms having an average of 44 acres of corn with an average yield of 40 bushels per acre.

Table 4. Labor, power, and equipment requirements for harvesting oats, by type of power and size of equipmnt, North Mississippi, 1954.

Operation	No. farms	Acres oats per farm	Yield per acre (bu.)	Acres per 10-hr. day	Hours per acre Man	Tractor	Truck	Trailer	Combine
Combining:									
5-ft., power take-off	13	31	42	9	2.2	1.1	----	----	1.1
5-ft., auxiliary engine	8	44	50	11	2.0	.9	----	----	.9
6-ft., power take-off	15	61	52	11	1.6	.9		----	.9
6-ft., auxiliary engine	38	43	48	11	1.5	.9			.9
10-to-14-ft., Self-propelled	18	82	52	20	.5	----	----	----	.5
Hauling:									
Truck, pickup	8	35	42	11	1.6	----	.9	----	----
Truck, 1½ ton	24	61	48	16	1.0	----	.6	----	----
Tractor and trailer	24	50	48	16	1.2	.6	----	.6	----

mower were the predominant sizes used, (Table 5). In general, the larger mowers were found on farms having the larger acreages of hay. However, in some instances both large mowers and small ones were found on the same farms.

Labor requirements for mowing using tractor mowers ranged from .5 hours per acre for 7-ft. mowers to .9 hours per acre for 5-ft. mowers. Use of 5-ft. mule mowers required an average of 1.2 hours of labor per acre.

Raking. Raking hay with a tractor side-delivery rake required .5 hours per acre, (Table 6). Use of a mule dump rake required an average of .7 hours per acre.

Baling. Automatic pick-up balers were the prevalent type used on the farms studied. This type baler with an auxiliary engine required only .6 hours of man labor per acre, compared to 2.1 hours for non-automatic pick-up balers and 4.1 hours for the stationary type baler, (Table 7). Hours of labor required per ton were about the same for all pick-up balers but slightly higher for stationary balers. Hay yields were considerably lower on farms using the latter type baler, and this probably accounts for some of the difference in labor requirements.

Stationary balers were generally used on farms having the smaller numbers of acres of hay. Of the pick-up type balers, those with auxiliary engines were generally on farms having larger acreages of hay than farms having power take-off type balers.

Hauling. As would be expected, labor requirements for hauling hay were considerably less for baled hay than for an equivalent amount of loose hay. Hours of labor required for hauling are presented in Table 8 by type of hauling equipment. Differences in requirements are no doubt due partly to differences in size of crew and in distance hauled as

Table 5. Labor, power, and equipment requirements[1] for mowing hay, by type of power and size of equipment, North Mississippi, 1954.

Size and type of equipment	No. farms	Acres hay per farm	Yield per acre per cutting (ton)	Acres per 10-hr. day	Hours per acre			
					Man	Tractor	Mule	Mower
5-ft., mule	16	28	1.39	8.3	1.2	..	2.4	1.2
5-ft., tractor	17	81	1.31	11.1	.9	.9	..	.9
6-ft., tractor	110	99	1.36	16.7	.6	.6	..	.6
7-ft., tractor	112	110	1.30	20.0	.5	.5	..	.5

[1] Requirements are for one cutting only.

Table 6. Labor, power, and equipment requirements[1] for raking hay, by type of power and equipment, North Mississippi, 1954.

Type equipment	No. farms	Acres hay per farm	Yield per acre per cutting (ton)	Acres per 10-hr. day	Hours per acre			
					Man	Tractor	Mule	Rake
Mule, dump	33	40	1.37	14.3	.7	..	1.4	.7
Tractor, dump	8	12	1.15	16.7	.6	.6	..	.6
Tractor, side delivery	195	115	1.37	20.0	.5	.5		.5

[1] Requirements are for one cutting only.

Table 7. Labor, power, and equipment requirements[1] for baling hay, by type of equipment, North Mississippi, 1954.

Type equipment	No. farms	Acres hay per farm	Yield per acre per cutting (ton)	Bales per 10-hr. day	Hours per acre		Hours per ton	
					Man	Tractor and baler	Man Tractor	and baler
Pick-up, automatic:								
Power take-off	38	93	1.43	618	.8	.7	.6	.5
Auxiliary engine	106	136	1.30	787	.6	.5	.5	.4
Pick-up, non-automatic:								
Auxiliary engine	17	167	1.48	771	2.1	.6	1.4	.4
Stationary:								
Power take-off	7	54	.95	411	4.1	.7	4.3	.7

[1] Requirements for one cutting only.

Table 8. Labor, power, and equipment requirements[1] for hauling hay, by type of power and equipment, North Mississippi, 1954.

Item	No. farms	Acres hay per farm	Yield per acre per cutting (ton)	Hrs. per acre			Hrs. per ton		
				Man	Power	Trailer or wagon	Man	Power	Trailer or wagon
Baled hay:									
2 ton truck	18	127	1.68	2.5	.7		1.5	.4	
1½ ton truck	93	135	1.25	2.7	.7		2.2	.6	
Pickup truck	9	41	1.70	3.2	1.1		1.9	.6	
Tractor	75	65	1.34	3.1	.8	.8	2.3	.6	.6
Mules	10	72	1.11	1.6	1.4	.7	1.4	1.2	.6
Loose hay:									
Tractor	9	16	1.44	3.6	1.3	1.3	2.5	.9	.9
Mules	11	18	1.36	6.1	4.4	2.2	4.5	3.2	1.6

[1] Requirements are for one cutting only.

well as to differences in type of hauling equipment used.

Harvesting Silage

Silage material is harvested by two general methods, field harvesters and binders. For the latter method, silage cutters and blowers are required. For the former method, blowers are required for up-right silos, but not for trench silos. In addition, use of a field harvester permits harvesting small grains, grasses, and legumes as silage material as well as corn and sorghum.

Time required to harvest an acre of silage material was roughly the same for 1-row binders and 1-row field harvesters (Table 9) but more labor was used with the former method. When silage was stored in trench silos, an average of 12.1 hours of man labor were required per acre with a 1-row binder, compared to an average of 6.9 to 7.9 hours when a 1-row field harvester was used. Similar differences were evident when silage was stored in upright silos.

Processing Feeds

Use of hammer mills to process feeds was quite a common practice on the farms studied. Both corn and hay was processed in this manner. In many instances blackstrap molasses was added during processing to make the feeds more palatable. Labor requirements to process one ton of feed averaged 2.3 man hours and .9 hours for equipment (Table 10). To crimp oats, an average of 4.1 man hours and 1.6 hours for equipment were required per ton.

Feeding Concentrates

Time required for feeding concentrates ranged from an average of .63 minutes to an average of 1.01 minutes per animal fed per feeding (Table 11). In general cattle were fed by use of buckets or carts or wheelbarrows when they were fed near where the feeds were stored. Trucks or tractors and trailers were used only when the feed had to be moved a considerable distance.

A savings in labor required by use of carts or wheelbarrows instead of buckets is evident from the data in Table 11. To feed 180 pounds of concentrates to 43 animals using buckets required .73 hours, or an average of 1.01 minutes per animal, compared to .67 hours, or an average of .63 minutes per animal, to feed 192 pounds of concentrates to 64 animals using carts or wheelbarrows. An average of 2 percent of all concentrates fed are estimated to have been wasted (Appendix Table 6).

Feeding Baled Hay

Baled hay was fed by hand when feeding was done near where the hay was stored and generally by use of trucks or tractor and trailer when the hay had to be moved considerable distances. About the same amount of man labor was required per animal per feeding for both methods, .82 hours and .81 hours (Table 12). More animals were fed when trucks or tractors and trailers were used, however. An estimated 10 percent of all baled hay fed to cattle was wasted.

Feeding Silage

As was the case with concentrates and baled hay, generally trucks and tractors were used in feeding silage only where a larger number of animals were to be fed and where the silage had to be moved a considerable distance, (Table 13). In other cases feeding was accomplished by using forks, buckets, carts, wheelbarrows, etc. Man labor required per animal per feeding ranged from an average of 1.01 minutes for carts and wheelbarrows from upright silos to an average 2.66 minutes for forks and buckets from a trench silo. The latter figure is based upon only 4 cases, but this in itself indicates that use of forks and buckets to feed silage from a trench silo is an inefficient method. Farmers interviewed estimated that an average of 4 percent of all silage fed was wasted.

Cost Of Operation

Cost of operation for harvesting and processing equipment includes (1) fixed cost items such as depreciation, interest on investment, and housing and (2) variable cost items, whenever applicable, such as repairs, fuel, and oil and oil filters. An important item which should be considered along with costs in determining which of two machines to buy is the relative amount of risk of weather damage. In general, such risk is smaller for larger machines that do the job more quickly. In some cases, a lessening of risk due to unfavorable weather may offset cost differences. On the other hand, alternative uses for money invested in farm equipment may make smaller items of equipment more economical, in spite of advantages held by the larger items.

Table 9. Labor, power, and equipment requirements[1] for harvesting and storing silage. North Mississippi, 1954.

Item	No. farms	Acres per farm	Yield per acre (ton)	Hours per acre					
				Man	Tractor	Truck	Trailer or wagon	Binder or harvester	Blower & silage cutter
Trench silo:									
1-row binder, hauled with truck	6	28	10.2	12.1	2.8	2.8		1.4	1.4
1-row harvester, hauled with truck	7	29	13.4	6.9	2.4	2.4		1.4	
1-row harvester, hauled with tractor	19	32	12.4	7.9	5.1		4.1	1.6	
Upright silo:									
1-row binder, hauled with truck	13	22	10.8	15.3	3.2	2.7		1.5	1.5
1-row binder, hauled with tractor	14	29	10.9	14.1	4.8		2.8	1.5	1.5
1-row harvester, hauled with truck	8	30	12.0	9.4	3.0	3.7		1.5	1.5
1-row harvester, hauled with tractor	18	29	12.3	10.3	5.3		4.2	1.7	1.5
2-row harvester, hauled with tractor	4	17	10.8	8.5	3.5		2.6	1.2	1.2

[1] Each item of power and equipment considered as being required for the harvesting operation for the time indicated even though it might not be in actual operation for the entire time.

Table 10. Labor requirements for processing feeds, North Mississippi, 1954.

Item	No. farms	Tons processed per farm	Hours per ton	
			Man	Equipment
Hammer mill	135	98	2.3	.9
Oat crimper	6	97	4.1	1.6

Table 11. Labor requirements for different methods of feeding concentrates to cattle, North Mississippi, 1954.

Item	No. operations reported	Average per operation reported				Average per animal per feeding	
		No. animals fed	Lbs. concentrates per feeding	Distance one way, ft.	Hours labor per feeding	Lbs. concentrates	Minutes labor
Buckets	273	43	180	59	.73	4.2	1.01
Carts	25	64	192	61	.67	3.0	.63
Trucks and tractors[1]	57	147	1,096	3,860	1.55	7.5	.63
Average	355[2]	61	328	669	.86	5.4	.85

[1] Total truck time or tractor and trailer time per feeding was 1.00 hours.

[2] Does not agree with total in appendix Table 5 because necessary details were not obtained on six operations.

Table 12. Labor requirements for different methods of feeding baled hay to cattle, North Mississippi, 1954.

Item	No. operation reported	Average per operation reported				Average per animal per feeding	
		No. animals fed	Bales of hay per feeding	Distance one-way ft.	Hrs. labor per feeding	Lbs. hay	Minutes labor
Hand	169	49	7	54	.67	4.5	.82
Trucks and tractors[1]	119	124	24	1,938	1.68	6.0	.81
Average	288	80	14	832	1.09	5.5	.82

[1] Total truck time or tractor and trailer time per feeding was 1.00 hrs.

Another important item which should be taken into account when comparing costs, is the fact that tractor costs differ for pulling a piece of equipment operated by power take-off from those incurred if the piece of equipment was operated by an auxiliary engine. Estimates of the Department of Agricultural Engineering indicate that tractor costs when pulling a machine operated by power take-off are higher by about the amount required for fuel and oil for the auxiliary engine. Whenever applicable, these amounts are indicated also.

Total variable cost especially, and to some extent depreciation, depends upon the extent of use of the particular item of equipment. The cost figures which are presented below are based upon the average amount of use on the farms studied. They should be interpreted in this light rather than as costs a farmer would expect to incur under a different set of circumstances. Still, the figures presented should be extremely valuable as an aid in determining the cost of operation under a different set of circumstances. Examples of how they might be used are given in the sections which follow on corn pickers and on hay harvesting equipment.

Corn Pickers

Initial cost of corn pickers averaged $896 for 1-row pickers and $1664 for 2-row pickers (table 14). Total annual cost averaged $171 and $292, respectively. For both sizes, depreciation accounted for over half of the total annual cost. Total fixed cost, including interest on investment and housing in addition to depreciation, accounted for 75 percent and 81 percent, respectively, for 1-row and 2-row pickers.

Total cost per day of operation amounted to $12 for 1-row pickers and $17 for 2-row pickers. But, since the 2-row pickers were used more days and covered a larger number of acres per day of use, cost per acre was less for the 2-row pickers ($1.21 compared to $1.69). Which machine an individual farmer would buy, however, would depend on the circumstances on his farm.

Suppose that a farmer has decided to buy a corn picker. Either a 1-row or 2-row machine can be used on his farm. He has 30 acres of corn to harvest each year. Which machine should he buy?

From Table 14 it appears that either machine should last about 10 years if used on only 30 acres each year. This would mean about $90 depreciation per year for the 1-row machine and about $166 depreciation for the 2-row machine. Interest on investment and housing would be about $33 for the 1-row machine and about $54 for the 2-row machine.

Thus, total fixed cost would be about $123 for the 1-row machine and about $220 for the 2-row machine.

From Table 14 also we see that variable cost (repairs) will amount to around $3 for the 1-row machine and around $4 for the 2-row machine per

Table 13. Labor requirements for different methods of feeding silage to cattle, North Mississippi, 1954.

Item	No. operation reported	Average per operations reported				Average per animal per feeding	
		No. animals fed	Lbs. silage fed per feeding	Distance one-way ft.	Hrs. labor per feeding	Lbs. silage	Minutes labor
Trench silo:							
Forks and buckets	4	32	942	48	1.42	29	2.66
Carts and wheelbarrows	1						
Trucks and tractors[1]	21	137	2,631	1,733	3.99	19	1.75
Average	27[2]	116	2,254	1,396	3.50	19	1.81
Upright silo:							
Forks and buckets	32	66	1,440	36	1.58	22	1.44
Carts and wheelbarrows	12	56	1,063	49	.94	19	1.01
Trucks and tractors[1]	15	183	4,035	1,021	3.90	22	1.28
Average	61[3]	97	1,851	285	1.86	19	1.15
All silos:							
Forks and buckets	39[4]	63	1,451	36	1.50	23	1.43
Carts and wheelbarrows	14[5]	59	1,258	51	1.13	21	1.15
Trucks and tractors[1]	46[6]	162	3,498	1,347	4.13	22	1.53
Average	102[7]	110	2,239	642	2.47	20	1.35

[1] Total truck time or tractor and trailer time per feeding was 2.27 hours for trench silos, 2.17 hours for upright silos, and 2.23 hours average for all silos.

[2] Includes one observation not classified as to method of feeding.

[3] Includes two observations not classified as to method of feeding.

[4] Includes three observations not classified by type of silo.

[5] Includes one observation not classified by type of silo.

[6] Includes ten observations not classified by type of silo.

[7] Includes all silos.

Table 14. Cost of operation and related information for corn pickers, North Mississippi, 1954.

Item	1-row	2-row
No. farms	37	7
10-hr days used during summer	14	18
Acres covered during year	100	257
Years useful life	9.4	9.1
Replacement cost (dollars)	896.00	1,664.00
Cost of operation (dollars):		
Total annual	169.42	311.60
Total fixed cost:	128.01	237.03
Depreciation	95.32	182.86
Interest on investment	22.40	41.60
Housing	10.29	12.57
Total variable cost (repairs)	41.41	74.57
Total per day	12.10	17.31
Total per acre	1.69	1.21

10-hr. day used. From Table 3 we see that machine time required to harvest one acre of corn with a 1-row picker is 1.4 hours and with a 2-row picker is .7 hours. In terms of 10-hour days, 4.2 days are required to harvest 30 acres with a 1-row picker and 2.1 days with a 2-row picker. This would mean about $13 repairs per year for the 1-row picker and about $8 repairs for the 2-row machine. Thus, total machine cost per year for harvesting 30 acres would be about $136 for the 1-row machine and about $228 for the 2-row machine.

The difference in labor and tractor time required (about 2 10-hr. days) should be considered too. If we count the extra labor at $4 per day and the extra[2] tractor costs at $7 per day,[3] the comparison would be $158 for the 1-row machine and $250 for the 2-row machine. Therefore, a 1-row machine would be much cheaper if only 30 acres were to be harvested.

If the same farmer had 200 acres of corn to harvest instead of 30 acres though, the answer would be different. The 1-row machine would probably last about 8 years and the 2-row machine about 9 if 200 acres were harvested each year. This would mean about $112 depreciation for the 1-row machine; thus, total fixed cost would be about $145. For the 2-row machine depreciation would be about $186 and total fixed cost would be about $240.

The 1-row machine would be used about 28 days and the 2-row machine would be used about 14 days. This would mean about $84 for repairs for the 1-row picker and about $56 for repairs for the 2-row picker. Total machine costs would be about $270 for the 1-row machine and about $296 for the 2-row machine. This would mean a difference of $26 in favor of the smaller machine. But the extra labor at $4 per day and the extra tractor time at $7 per day would mean to save the $26, an additional cost of $154 would have to be incurred.

Thus, the larger machine would be cheaper when all costs were considered. In addition, the 28 days required for harvesting by the 1-row machine may be longer than the corn would remain in a condition suitable for harvesting by machine.

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[2] The total cost of operating a tractor two days should not be counted in since a part of the total cost (fixed costs) would be about the same regardless of whether it was used the extra two days or not. The small difference in tractor costs per day as a result of pulling a 1-row machine instead of a 2-row machine is ignored in the above calculations.

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[3] A large tractor was used to pull both type machines in the majority of cases on the farms studied. See Appendix Table 1.

Combines

Replacement cost of combines ranged from an average of $1,508 for the 5-ft. power take-off type to $5,275 for the self-propelled type. (Table 15). Total annual cost for the pull-type machines ranged from $304 for the 5-ft. power take-off machine to $412 for the 6-ft. machine equipped with an auxiliary engine. Total annual cost averaged $1,020 for the self-propelled type combine.

Total fixed cost accounted for an average of from 73 percent to 82 percent of the total cost of operation. Depreciation was by far the most important fixed cost item.

Variable cost (that part of total cost which depends to a considerable extent upon the amount of use) was naturally higher for combines equipped with auxiliary engines than for those not so equipped. Variable cost ranged from an average of $64 for 5-ft. power take-off combines to $102 for 6-ft. combines equipped with auxiliary engines and averaged $274 for self-propelled combines.

Total cost per day of operation and per acre covered was highest for the 5-ft. combine equipped with auxiliary engine. The fact that this type combine was used only an average of 7 days per year compared to from 10 to 20 days for the other types accounts in part for the higher total cost per day and per acre covered.

Hay Harvesting Equipment

Different types of equipment may be substituted for each other in either of the four stages of the hay harvesting operation—mowing, raking, baling, and hauling. Thus costs for various types of equipment are discussed separately for each stage of the harvesting operation.

Mowers. Initial costs of 6-ft. and 7-ft. tractor mowers were essentially the same, $299 and $300, (Table 16). Five-ft. tractor mowers were somewhat lower priced, averaging $216. Replacement cost of mule mowers averaged $168 each.

Total annual cost of operation for the tractor mowers ranged from $69 for the

Table 15. Cost of operation and related information for combines, North Mississippi, 1954.

	5-ft.		6-ft.		
Item	Power take-off	Auxiliary engine	Power take-off	Auxiliary engine	Self propelled
No. farms	16	25	13	43	12
10-hr. days used during year	10	7	13	11	20
Acres covered during year	91	78	144	122	400
Years useful life	8.2	8.8	8.0	8.5	8.9
Replacement cost (dollars)	1,508.00	1,876.00	1,829.00	2,036.00	5,275.00
Cost of operation (dollars):[1]					
Total annual:	303.96	365.72	359.58	411.77	1,020.38
Total fixed cost:	239.54	278.02	294.17	310.26	746.76
Depreciation	183.90	213.18	228.62	239.53	592.70
Interest on investment	37.70	46.90	45.72	50.90	31.88
Housing	17.94	17.94	19.83	19.83	22.18
Total variable cost:	64.42	87.70	65.41	101.51	273.62
Repairs	64.42	69.91	65.41	71.57	158.21
Gasoline		15.26		26.40	110.83
Oil and oil filters		2.53		3.54	4.58
Total per day	30.40	52.25	27.66	37.43	51.02
Total per acre	3.34	4.69	2.50	3.38	2.55

[1] Additional tractor costs for pulling the 5-ft. power take-off combine over and above those for pulling the 5-ft. machine equipped with auxiliary engines would total about $25.41, or about $2.54 per day and $.28 per acre. For the 6-ft. power take-off combine, additional tractor costs would total about $35.39, or about $2.72 per day and $.25 per acre. See text.

5-ft. size to $84 for the 6-ft. size. Total annual cost of operating mule mowers averaged $31. On the average, cost of operation was approximately evenly divided between fixed cost items and variable cost items. Depreciation was the major item of fixed cost and repairs the only items of variable cost.

Operating cost per day of use ranged from $2.79 for mule mowers to $4.59 for the 7-ft. tractor mowers. Contrarywise, cost of operation per acre covered was lowest for the 7-ft. tractor mower ($.23) and highest for mule mowers ($.33). This situation was due to the wide difference in acres covered per day of use.

Rakes. Initial cost of tractor side-delivery rakes was almost four times as great as the initial cost of mule dump rakes, $375 compared to $99, (Table 17). Considerable difference was also found in years of estimated life of the two types of rakes. Estimated life of mule dump rakes was 21.1 years compared to 8.4 years for the side-delivery rakes.

Annual cost of operation averaged $14 for mule dump rakes and $95 for tractor side-delivery rakes. For both type rakes, fixed cost items, of which depreciation was the most important, accounted for over one-half of the total cost of operation.

Cost per day of operation averaged $2.35 for mule dump rakes and $5.94 for tractor side-delivery rakes. Cost per acre

Table 16. Cost of operation and related information for mowing machines, North Mississippi, 1954.

Item	Mule mowers	Tractor mowers		
		5-ft.	6-ft.	7-ft.
No. farms	29	18	113	101
10-hr. days used during year	11	20	20	18
Acres covered during year	92	222	333	360
Years useful life	14.8	9.2	9.2	9.2
Replacement cost (dollars)	168	216	299	300
Cost of operation (dollars):				
Total annual:	30.68	69.44	83.92	82.60
Total fixed costs:	18.92	32.28	44.34	43.61
Depreciation	11.35	23.48	32.50	32.61
Interest on investment	4.20	5.40	7.48	7.50
Housing	3.37	3.40	3.46	3.50
Total variable cost (repairs)	11.76	37.16	40.48	38.99
Total per day	2.79	3.47	4.20	4.59
Total per acre	.33	.31	.25	.23

Table 17. Cost of operation and related information for hay rakes, North Mississippi, 1954.

Item	Tractor side-delivery	Mule dump
No. farms	139	40
10-hr. days used during year	16	6
Acres covered once over	320	86
Years useful life	8.4	21.1
Replacement cost (dollars)	375	99
Cost of operation (dollars):		
Total annual:	95.02	14.11
Total fixed cost:	59.17	9.71
Depreciation	44.64	4.69
Interest on investment	9.38	2.48
Housing	5.15	2.54
Total variable cost (repairs)	35.85	4.40
Total per day	5.94	2.35
Total per acre	.30	.16

covered was also lower for the mule dump rakes, $.16 compared to $.30.

Balers. Replacement cost of hay balers ranged from $923 for the stationary balers operated by power take-off to $2,512 for the automatic pick-up baler with auxiliary engine, (Table 18). Replacement cost of automatic pick-up balers operated by power take-off and non-automatic pick-up balers with auxiliary engine averaged essentially the same, $1,651 and $1,650.

Total annual cost of operation for the different types ranges from $141 for the stationary baler operated by power take-off to $517 for the automatic pick-up baler with auxiliary engine. Of the total, fixed cost items accounted for from 64 percent to 80 percent. Depreciation was the main item of fixed cost.

Operating costs per day of operation ranged from $11 for stationary balers operated by power take-off to $27 for automatic pick-up balers with auxiliary engine. Costs per acre ranged from $.76 to $1.69. The stationary baler operated by power take-off had the lowest cost per acre and the automatic pick-up baler operated by power take-off had the highest cost per acre.

Cost of operation per bale was considerably lower for the non-automatic pick-up baler operated with auxiliary engine than for either of the other three types of balers. Total cost of operation for this type baler was only 1.7 cents per bale compared to 3.0 cents, 3.1 cents, and 3.4 cents for the automatic pick-up baler equipped with auxiliary engine, the stationary baler operated by power take-off, and the automatic pick-up operated by power take-off respectively.

Since a large proportion of the total

Table 18. Cost of operation and related information for hay balers, North Mississippi, 1954.

Item	Pick-up			Stationary, power take-off
	Automatic		Non-automatic, auxiliary engine	
	Power take-off	Auxiliary engine		
No. farms	10	66	13	18
10-hr. days used during year	14	19	30	13
Acres covered during year	200	380	500	186
Bales baled during year	10,044	17,445	22,921	4,578
Years useful life	7.9	8.5	8.3	11.7
Replacement cost (dollars)	1,651	2,512	1,650	923
Cost of operation (dollars)[1]				
Total annual:	338.22	517.28	398.00	140.85
Total fixed cost:	264.56	372.66	253.93	112.29
Depreciation	208.99	295.53	198.80	78.89
Interest on investment	41.28	62.80	41.25	23.07
Housing	14.29	14.33	13.88	10.33
Total variable cost:	73.66	144.62	144.07	28.56
Repairs	73.66	96.59	69.31	28.56
Gasoline		43.34	68.18	
Oil and oil filters		4.69	6.58	
Total per day	24.16	27.23	13.27	10.83
Total per acre	1.69	1.36	.80	.76
Total per bale[2]	.034	.030	.017	.031

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[1] Additional tractor costs for pulling the automatic pick-up power take-off baler over and above those for pulling one with auxiliary engine would total about $35.39; this would be about $2.53 per day, about $.18 per acre, and about $.004 per bale. See text.

[2] Differences in cost of material used in tying bales, if any, should also be considered in cost comparisons. Information as to these differences were not secured in this study, however.

cost of operating a hay baler is accounted for by items which are relatively fixed regardless of amount of use, the extent of use has considerable influence on costs per unit. The cost of the relatively fixed items is spread over more units. Difference in cost per bale, per acre, and per day are due in part to difference in amount of use. Machine costs would not be the only consideration in deciding which of two types of machines to purchase, however. The example below illustrates the point.

Suppose a farmer had 500 acres of hay to bale, his own plus some custom baling for his neighbors. He is trying to decide whether to buy an automatic pick-up with auxiliary engine or a non-automatic pick-up with anxiliary engine. If he buys the former, he does not have to hire any labor for the hay baling. But if he buys the latter he has to hire labor for the tying. We can calculate from the figures in Table 7 that the number of 10-hr. days required to do the job will be about 25 with the former and about 30 with the latter. Thus, two men for the tying at $4 per day for 30 days would cost $240. If a large tractor is used to pull the baler, 5 extra days at about $7 per day would be about $35 extra tractor costs associated with the non-automatic type baler. These costs, together with the $398 machine cost for the non-automatic pick-up baler would total $673 for hired labor, machine, and added tractor costs.

For the automatic pick-up baler with auxiliary engine we can estimate years of useful life at about the same as for the non-automatic pick-up baler with auxiliary engine, if it is to be used on the same number of acres. We would estimate depreciation, based on 8.3 years of useful life, to be about $303 Interest on investment would be about $63 and housing about $14. Thus, total fixed cost of the automatic pick-up baler with auxiliary engine would be around $380, if used on 500 acres.

From Table 18 we see that variable cost amounted to $144.62 for 19 days of use, or about $7.60 per day. For 25 days, variable costs would amount to around $190. Thus, total machine costs for this type baler to harvest 500 acres per year would be about $570. The farmer would save the difference between $673 and $570 each year by buying the automatic baler. In addition, he would work about 5 days less himself.

On the other hand, if he had unpaid family labor to do the tying, extra tractor costs and machine costs for the non-automatic pick-up baler with auxiliary engine would total only about $433 compared to a machine cost of about $570 for the automatic pick-up baler with auxiliary engine. Differences in cost of material used in tying bales should also be considered before reaching a final decision. Such differences are usually in favor of the automatic baler.

Ensilage Equipment

Replacement cost of 1-row forage harvesters averaged $2,023 and $2,258, respectively, for power take-off machines and harvesters equipped with auxiliary engines (Table 19).

Annual cost of operation totaled $377 and $486, respectively, for the two types of harvesters. Fixed cost, of which depreciation was by far the most important item, accounted for approximately three-fourths of the total. Total cost per day of operation, per acre, and per ton was about the same for the two types of harvesters.

Initial cost of 1-row binders was low relative to initial cost of forage harvesters, averaging $557 each. Annual cost of operation averaged $93 and cost of operation per day, per acre, and per ton amounted to $15.50, $2.33, and $.22 respectively.

Replacement cost of ensilage cutters and blowers averaged $513. On an annual basis, cost of operation amounted to $74. Per day, per acre, and per ton figures

Table 19. Cost of operation and related information for ensilage equipment, North Mississippi 1954.

Item	Ensilage cutter and blower	1-row binder	1-row forage harvester	
			Power take-off	Auxiliary engine
No. farms	47	41	32	8
10-hr. days used during year	6	6	11	14
Acres covered during year	43	40	63	92
Tons harvested during year	461	429	784	1,144
Years useful life	13.1	11.6	8.2	8.1
Replacement cost (dollars)	513.00	557.00	2,023.00	2,258.00
Cost of operation (dollars):[1]				
Total annual:	74.40	93.01	376.96	485.73
Total fixed cost:	58.29	67.16	313.74	351.66
Depreciation	39.16	48.02	246.71	278.76
Interest on investment	12.82	13.92	50.58	56.45
Housing	6.31	5.22	16.45	16.45
Total variable cost:	16.11	25.85	63.22	134.07
Repairs	16.11	25.85	63.22	73.33
Gasoline				54.70
Oil and oil filters				6.04
Total per day	12.40	15.50	34.27	34.70
Total per acre	1.73	2.33	5.98	5.28
Total per ton	.16	.22	.48	.42

[1] Additional tractor costs for pulling the 1-row forage harvester operated by power take-off over and above those for pulling the machine equipped with auxiliary engine would total about $47.75 This would be about $4.34 per day, $.76 per acre, and $.06 per ton. See text.

were $12.40, $1.73, and $.16, respectively.

Feed Processing Equipment

Cost information was secured on 6 oat crimpers and 135 hammer mills. Replacement cost of these items of equipment averaged $167 and $384, respectively, (Table 20).

Cost of operation annually amounted to $27 for oat crimpers and $53 for hammer mills. Per day of operation, costs totaled $1.71 and $5.87, respectively. On a "per ton processed" basis, total cost amounted to $.28 and $.54, respectively.

Custom Work

Harvesting equipment for feed and forage crops is quite specialized. As a result, fixed cost is necessarily high for a farmer who has only a few acres on which the equipment can be used. Thus, many farmers follow either the practice of hiring a part of the specialized equipment needed on a custom basis, or buying it with the intention of doing work for other farmers on a custom basis to defray a part of the cost of owning the equipment. Others sometimes buy specialized harvesting equipment for the sole purpose of doing custom work. For the harvesting operations studied, baling hay was the job most frequently reported as being hired on a custom basis (Appendix Table 7). Raking hay, combining oats, and cutting and storing ensilage were others quite frequently done on a custom basis. Custom rates for performing several operations are presented in Appendix Table 8.

Cost of Storing Feed and Forage

In general, several different types of facilities were used for storing feed and forage crops. In many cases, the same facility may be used to store several different feed and forage crops. In the discussion below, cost of storage for corn, oats, hay and silage is presented for the different types of facilities in which they were stored on the farms studied.

Corn

Corn was stored in general barns, corn cribs, granaries, and tenant houses. The average quantity stored in each type facility ranged from 101 bushels per tenant house to 1,124 bushels per corn crib (Table 21). Annual cost of buildings chargeable to corn storage ranged from an average of from 5.0 cents per bushel for general barns to 7.4 cents for granaries.

Oats

Oats were stored in general barns, oat cribs, granaries, and tenant houses. The quantity stored per building ranged from 272 bushels for general barns to 1,589 bushels for granaries (Table 22). Building costs chargeable to oat storage ranged from an average of 4.9 cents per bushel for oat cribs to 6.1 cents for tenant houses.

Hay

General barns, barns built especially for hay storage, and tenant houses were used for hay storage. An average of 11 tons per building was stored in tenant

Table 20. Cost of operation and related information for feed processing equipment, North Mississippi, 1954.

Item	Oat crimper	Hammer mill
No. farms	6	135
10-hr. days used during year	16	9
Tons processed during year	97	98
Years useful life	18.8	15.1
Replacement cost (dollars)	167.00	384.00
Cost of operation (dollars):		
Total annual:	27.37	52.81
Total fixed cost:	17.29	41.16
Depreciation	8.88	25.43
Interest on investment	4.18	9.60
Housing	4.23	6.13
Total variable cost (repairs)	10.08	11.65
Total per day	1.71	5.87
Total per ton	.28	.54

Table 21. Cost of storing corn in different types of facilities, North Mississippi, 1954.

Item	General barn	Corn crib	Granary[1]	Tenant house
Annual cost per building charged to corn (dollars)[2]	24.30	57.14	44.99	6.18
Corn stored per building (bushels)	489	1,124	610[1]	101
Cost of storage per bushel (cents)	5.0	5.1	7.4	6.1

[1] Where only corn was stored in the granary. an average of 1,514 bushels of corn was stored per granary.

[2] See Appendix Table 8 for detailed cost.

Table 22. Cost of storing oats in different types of facilities, North Mississippi, 1954.

Item	General barn	Corn crib	Granary[1]	Tenant house
Annual cost per building charged to oats (dollars)[2]	14.84	75.78	85.91	28.10
Oats stored (bushels)	272	1537	1589[1]	463
Cost of storage per bushel (cents)	5.5	4.9	5.4	6.1

[1] Where only oats were stored in the granary, an average of 1,635 bushels were stored per granary.

[2] See Appendix Table 8 for detailed cost.

houses which were used for hay storage compared to 44 tons per building for general barns and 86 tons per building for hay barns (Table 23). Building costs for hay storage averaged around $2.50 per ton or about 8 cents per bale.

Silage

Trench silos appear to offer a cheaper method of storing silage than upright silos, if a comparison is made on the basis of annual cost of the storage facility only. Total facility cost amounted to only 16 cents per ton for trench silos compared to 55 cents for upright silos (Table 24).

Table 23. Cost of storing hay in different types of facilities, North Mississippi, 1954.

Item	General barn	Hay barn	Tenant house
Annual cost per building charged to hay (dollars)[1]	116.18	211.05	28.10
Hay stored per building (tons)	44	86	11
Cost of storage per ton (dollars)	2.64	2.45	2.55
Cost of storage per bale (cents)	8.4	7.8	8.2

[1] See Appendix Table 8 for detailed cost.

Table 24. Cost of storing silage in upright and trench silos, North Mississippi, 1954.

Item	Upright silo	Trench silo
Annual cost per silo (dollars)[1]	87.00	38.69
Silage stored per silo (tons)	157	246
Cost per ton of silage stored (dollars)	.55	.16

[1] See Appendix Table 8 for detailed cost.

APPENDIX

Appendix Table 1. Source of power[1] for corn harvesting operation, North Mississippi, 1954.

Operation	No. farms reporting	Percentage of farms using Large tractors	Medium tractors	Small tractors
Picking:				
1-row picker	91	57.1	42.9	0
2-row picker	15	80.0	20.0	0
Hauling:[2]				
Tractor and trailer	160	31.9	65.6	2.5

[1] Tractors of over 24 h. p. were classified as large, from 18-24 h. p. as medium, and less than 18 h. p. as small.

[2] Trucks were used for hauling on 29 farms. On these farms ½, 1, 1½, and 2 ton trucks were used in 6.9, 3.5, 7.2, and 17.2 percent of the cases respectively.

Appendix Table 2. Source of power[1] for oat harvesting operations, North Mississippi, 1954.

Operation	No. farms reporting	Percentage of farms using Large tractors	Medium tractors	Small tractors
Combining				
5-ft power take-off	13	84.6	15.4	0
5-ft auxiliary engine	8	100.0	0	0
6-ft. power take-off	15	80.0	20.0	0
6-ft. auxiliary engine	36	38.9	58.3	2.8
Hauling:[2]				
Tractor and trailer	24	41.7	58.3	0

[1] See footnote 1 Appendix Table 1.

[2] Trucks were used for hauling on 40 farms. On these farms ½, 1, 1½, and 2 ton trucks were used in 20, 10, 60, and 10 percent of the cases, respectively.

Appendix Table 3. Source of power[1] for hay harvesting operations, North Mississippi, 1954.

Operation	No. farms reporting	Percentage of farms using		
		Large tractors	Medium tractors	Small tractors
Mowing:				
5-ft. mower	17	0	52.9	47.1
6-ft. mower	110	29.1	66.4	4.5
7-ft. mower	109	45.0	51.4	3.6
Raking:				
Side-delivery	187	28.9	65.3	5.9
Baling:				
Automatic pick-up, power take-off	37	54.1	45.9	0
Automatic pick-up, auxiliary engine	103	45.6	54.4	0
Non-automatic pick-up, auxiliary engine	16	56.2	43.8	0
Stationary	8	12.5	87.5	0
Hauling (tractor and trailer)[2]				
Bales	83	39.8	60.2	0
Loose	8	0	100.0	0

[1] See footnote 1 Appendix Table 1.

[2] Trucks were used to haul baled hay on 120 farms. On these farms ½, 1½, and 2 ton trucks were used in 7.5, 77.5, and 15.0 percent of the cases, respectively.

Appendix Table 4. Source of power for silage harvesting and storage operations, North Mississippi, 1954.

Operation	No. farms reporting	Percent of farms using		
		Large tractors	Medium tractors	Small tractors
Field harvester:				
1-row harvester	56	66.1	32.1	1.8
Hauling chopped silage[1]	62	35.5	61.3	3.2
Blowing silage into upright silo	18	77.8	22.2	0
Packing silage in trench silo	14	28.6	71.4	0
Bound silage:				
1-row binder	47	27.7	72.3	0
Hauling bound silage[2]	33	33.3	66.7	0
Storing silage in upright silo	32	71.9	28.1	0
Storing silage in trench silo	6	33.3	66.7	0

[1] Trucks were used to haul chopped silage on 14 farms. On these farms 1½ ton and 2 ton trucks were used in 93.8 and 6.2 percent of the cases, respectively.

[2] Trucks were used to haul bound silage on 30 farms. On these farms 1, 1½, and 2 ton trucks were used in 6.7, 60.0, and 33.3 percent of the cases, respectively.

Appendix Table 5. Feeding intervals and crew size for feeding cattle, North Mississippi, 1954.

Item	Feeding intervals			Number men feeding		
	One time daily	Two times daily	Not fed daily	One	Two	Three or more
			No. farms			
Concentrates:						
Dairy cattle	28	138	0	124	42	0
Beef cattle	134	43	18	139	50	6
Total	162	181	18	263	92	6
Hay:						
Dairy cattle	80	32	8	82	35	3
Beef cattle	133	33	2	96	58	14
Total	213	65	10	178	93	17
Silage:						
Dairy cattle	26	42	0	33	32	3
Beef cattle	31	3	0	10	19	5
Total	57	45	0	43	51	8

Appendix Table 6. Percentage of feed and forage wasted when fed to cattle, North Mississippi, 1954.

Item	Number operations reported	Number animals fed per group	Lbs. per animal per day	Percent wasted
Concentrates	361	61	7	1.6
Hay	288	80	14	9.6
Silage	102	110	35	3.6

Appendix Table 7. Number and percent of farmers hiring custom work or doing custom work for other farmers for specified operations, 304 farms, North Mississippi, 1954.

Crop and operation	Number farmers reporting	Number farmers		Percent of farmers	
		Hiring custom work	Doing custom work	Hiring custom work	Doing custom work
Corn:					
Picking	244	6	7	2	3
Hauling	244	0	0	0	0
Oats:					
Combining	161	41	18	25	11
Hauling	161	3	1	2	1
Hay:[1]					
Mowing	272	25	15	9	6
Raking	272	61	18	22	7
Baling	246	89	21	36	9
Hauling	272	12	6	4	2
Silage:					
Cutting	118	26	12	22	10
Hauling	118	17	4	14	3
Storing	118	24	6	20	5

[1] Of the 114 farmers reporting hiring or doing custom work, 30 reported baling only, 39 raking and baling, 23 mowing, raking and baling, and 14 mowing, raking, baling, and hauling.

Appendix Table 8. Custom rates for specified harvesting operations, North Mississippi, 1954.

Crop and harvesting operation	Unit	Range[1]	Usual rate
		Dollars	
Corn :			
Picking	Acre	6.00 - 6.50	6.00
Oats:			
Combining	Acre	5.00 - 7.50	6.00
Hay:			
Baling	Bale	.15 - .20	.15
Raking and baling	Bale	.20 - .25	.20
Mowing, raking, and baling	Bale	.25 - .30	.25
Mowing, raking, baling, and hauling	Bale	.30 - .35	.35
Silage:			
Cut	Ton	1.00 - 2.00	1.50
Cut and store[2]	Ton	1.50 - 2.50	2.00
Cut, haul, and store	Ton	2.50 - 3.50	3.00
Processing feeds (hammer mill)	Cwt.	.20 - .35	.25

[1] Range within which most reported custom rates fell.

[2] Hauling done by farmer; cutting and storing only by custom operator.

Appendix Table 9. Annual cost and related information for feed and forage storage facilities, North Mississippi, 1954.

Item	General barn	Hay barn	Tenant houses	Granary	Corn crib	Oat crib	Upright silo	Trench silo
No. farms	248	105	35	40	101	42	81	46
No. of buildings	415	182	73	64	145	59	124	58
Yrs. of useful life	31	37	23	22	28	25	37	15
Replacement cost (dollars)	3195	3277	656	1670	707	816	1223	241
Annual cost (dollars):								
Depreciation	103.06	88.57	28.52	75.91	25.25	32.64	33.05	16.07
Interest	79.88	81.92	16.40	41.75	17.68	20.40	30.58	6.02
Insurance	22.01	10.24	3.74	4.44	1.72	4.46	0	0
Repairs	58.09	40.22	19.03	15.64	12.78	21.17	23.37	16.60
Total	263.04	220.95	67.69	137.74	57.43	78.67	87.00	38.69
Annual cost (dollars) charged to:								
Corn	24.30		6.18	44.99	57.14			
Oats	14.84		28.10	85.91		75.78		
Hay	116.18	211.05	28.10					
Silage							87.00	38.69
Other uses	107.71	9.90	5.31	6.84	.29	2.89		

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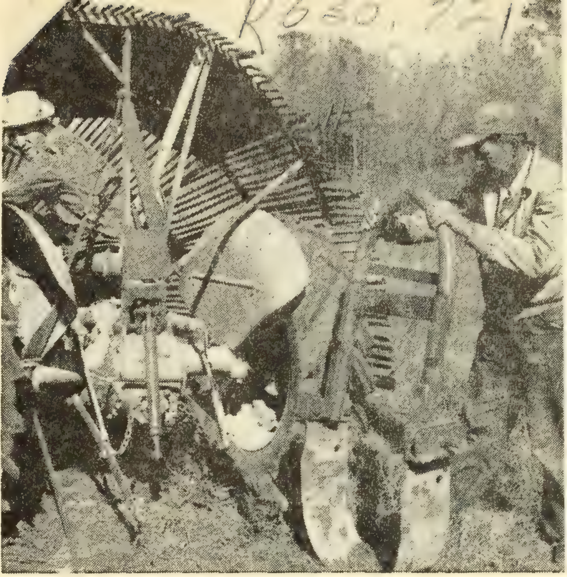
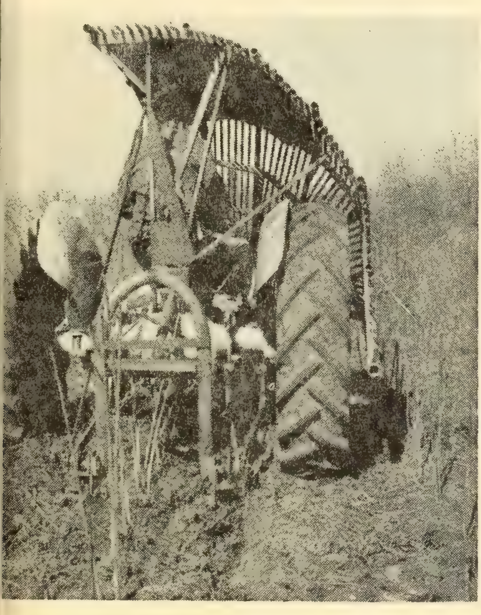


Machinery in Tung Orchard Management



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The photograph in Figure 8 was furnished through the courtesy of the Horticultural Crops Research Branch.

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On the cover: Figure 3. A "U" type blade used for digging tung trees in a nursery is shown at the top ready to be attached to a tractor. The tree digger is shown in operation at the bottom. It cuts the roots at the proper length and also loosens the soil about the tree roots making it possible to lift the trees out of the ground without any further digging.

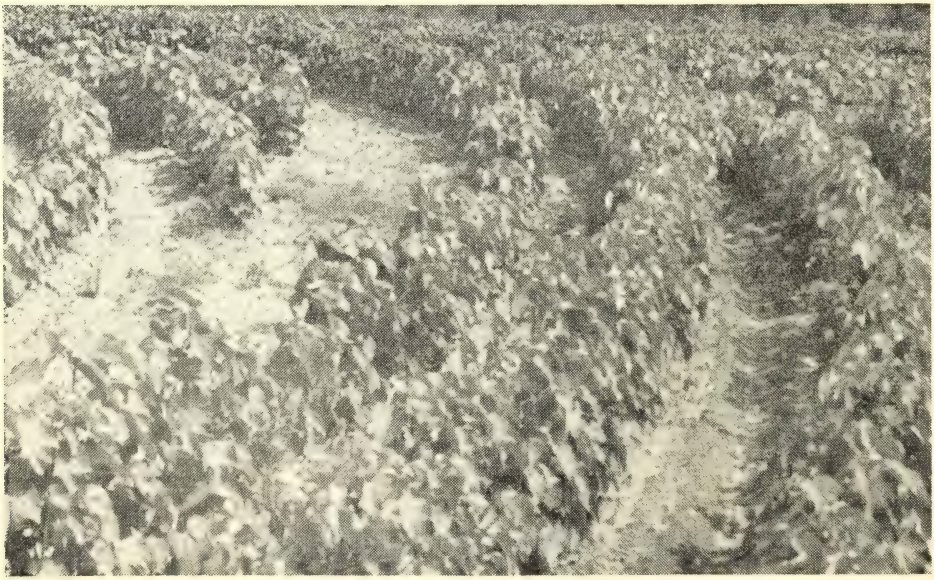

Fig. 1. Tung nursery planted on the contour with the rows spaced so that they could be cultivated with a standard row-crop corn cultivator. Note the point rows and space left at the ends for turning equipment.

MACHINERY IN TUNG ORCHARD MANAGEMENT

By W. W. KILBY and R. E. JEZEK[1]

Tung was first introduced into the United States in 1905 from seed that was received by the United States Plant Introduction Gardens, Chico, California, from L. S. Wilcox, Consul General, at Hankow, China. During several succeeding years tung seed and seedlings were distributed to several State Agricultural Experiment Stations and private cooperators in the extreme southern part of the United States.

The first commercial plantings were made in Florida in 1924. The industry has progressed across the southern part of the Gulf States in a belt about 100 miles wide from the Gulf of Mexico northward and from east Florida to east Texas.

When tung was first planted in commercial orchards in this country, the cultural methods used were similar to those practiced in China. In China tung is grown with little or no cultivation or fertilization and not generally in an orchard design. Yields and oil content are low, but due to the low cost of labor and other production factors tung is a profitable industry for the Chinese under these conditions.

However, in the United States where the cost of labor is many times greater, it was soon found necessary to increase the production per acre in order to have a profitable commercial industry. To obtain a profitable production per acre, it is necessary to establish a fertilization program, to adapt machinery used in other crops to tung orchard requirements and to develop other equipment that would lend itself to orchard cultivation in the hill land of the sandy Gulf coastal area.

The purpose of this bulletin is to acquaint the tung grower with the best types of machinery and their usage in tung production.

Planting

Generally tung orchards are established by planting seed in place in the orchard or by planting one-year-old tung seedlings to a contoured planting plan at desired spacing in the orchard.

In planting a tung nursery the soil should be broken with a turning plow and the seed bed prepared as for corn. If the nursery is planted on a slope that is more than 4%, the rows should be planted on the contour and spaced so that the young seedlings may be cultivated with conventional row-crop equipment. (See Figure 1.)

Frequently tung seed are dropped into furrows by hand, a slow laborious method. A special plate has been designed to adapt a conventional corn and cotton planter for planting tung seed. The plate was made with openings of 1-1/16 inch width slots. The planter was geared to drop seed eight inches apart. (Fig. 2.)

When trees in the nursery are ready to be transplanted to the orchard, they must be loosened in the soil and the roots severed. Young trees should have as much of the root system left intact as is practical. The tree digger cuts the roots at about 12 inches below the surface and 10 inches on each side of the trunk. It also loosens the soil about the tree roots making it possible to lift the trees out of the ground without any further digging. A tree-digger of this type greatly reduces labor required in digging the trees in the nursery. It leaves the root system in a much better condition for transplanting to the orchard than generally results when trees are dug with a shovel. (See cover.)

---

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Tung is most generally planted on land with a rolling terrain and therefore contour rows are necessary to help control soil erosion. After the contour line has been laid out,[2] a strip 8 to 10 feet wide should be thoroughly disked along the tree row to prepare for planting the trees.

The most economical way to plant a new orchard is to open a trench, one foot deep and about 18 inches wide, by the use of a lister (middle buster). The trees are then set in the furrow at the desired spacing which is usually 8 to 12 feet apart. Two men working together, one holding the tree and tramping the soil about the roots as the other shovels, make an efficient planting team. The trench left between the trees in the row is simply filled by using a one-way disc tiller. By using this method, a crew of four, consisting of one tractor driver, one man to drop trees into the trench at the desired spacing and two men to set the trees, can plant approximately 65 to 70 trees per hour. (Figs. 4 and 5.)

A comparison of the number of trees planted per man per day by three methods is shown in Table 1.

All of these methods of planting were tried in Savannah soil type. The rate of planting would no doubt be faster in light soil and slower in heavier soil.

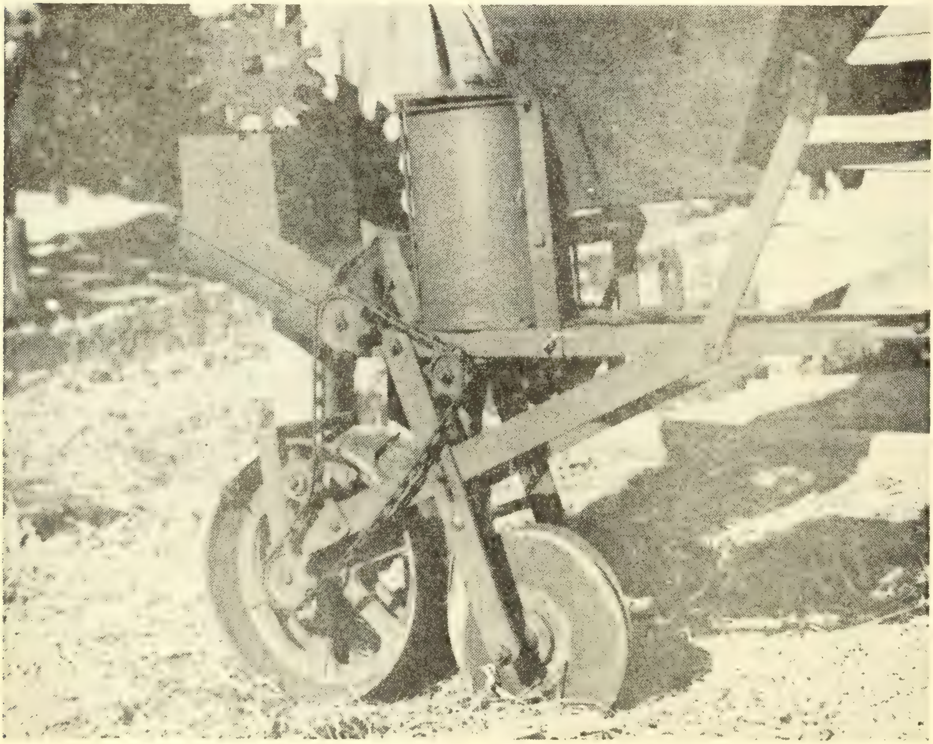

Fig. 2. A special plate with openings of 1-1/16 in. slots to take tung seed was made for a conventional corn and cotton planter. The seed should be graded to uniform size. The planter is geared to drop the seed eight inches apart. This method of planting has been used successfully by commercial nurserymen.

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[2] See Farmer's Bulletin No. 2031, United States Department of Agriculture, 1951, page 9.

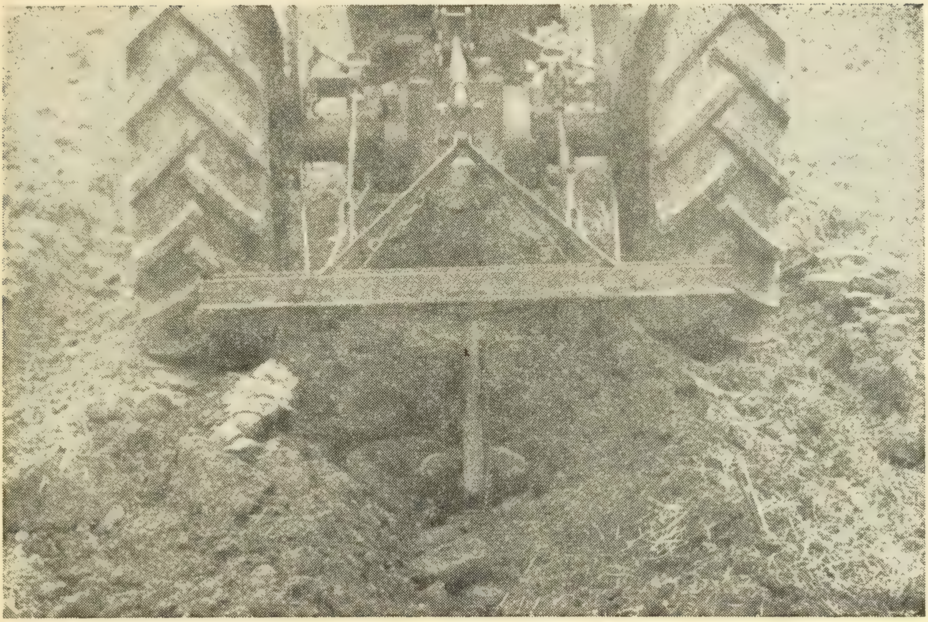

Fig. 4. A lister plow (middle buster) is shown opening a trench about one foot deep and about eighteen inches wide. A speed of 4 to 5 miles per hour is desirable in order to throw the soil out of the trench. Some times it is desirable to make a second trip to remove loose soil from the trench.

Table 1. Planting tung seedlings in the orchard.

Method of planting	Number of trees planted per man per day
Hand shovel	100
Tractor-powered auger	305
Lister plow (middle buster)	548

*Eight hours of work

Where it is necessary to replace trees or fill rows in an old orchard, a tractor-powered, post-hole auger of 18-inch diameter may be used with a minimum labor for digging holes (Fig. 6). The tractor-powered auger method is limited by the number of holes that can be bored in a day. Additional tree setters are needed to keep up with the auger because in setting the tree it is necessary to completely fill the hole with soil. Where the lister plow is used to open a trench, the trees are set in the trench with just enough soil packed firmly around the roots to hold them erect. The trench is then filled with a one-way disc tiller.

When either of the above described methods is used, it is important that the soil be firmly packed around the root system of the trees. The best time to transplant tung trees is between January 15 and March 15, the early part of this period being preferred. It is also important that roots of trees should not be exposed to the air when the temperature is below 32° F. and if possible they should be planted in the orchard the same day they are removed from the nursery. If this is not possible, it is advisable to heel them in. A quick way to do this is to open a furrow and place the roots in the trench slanting the trees at about 45° angle. As the soil is moved to cover the roots, another furrow is opened for the next row of trees. Soil should be firmed around the roots to protect them from drying out or freezing.

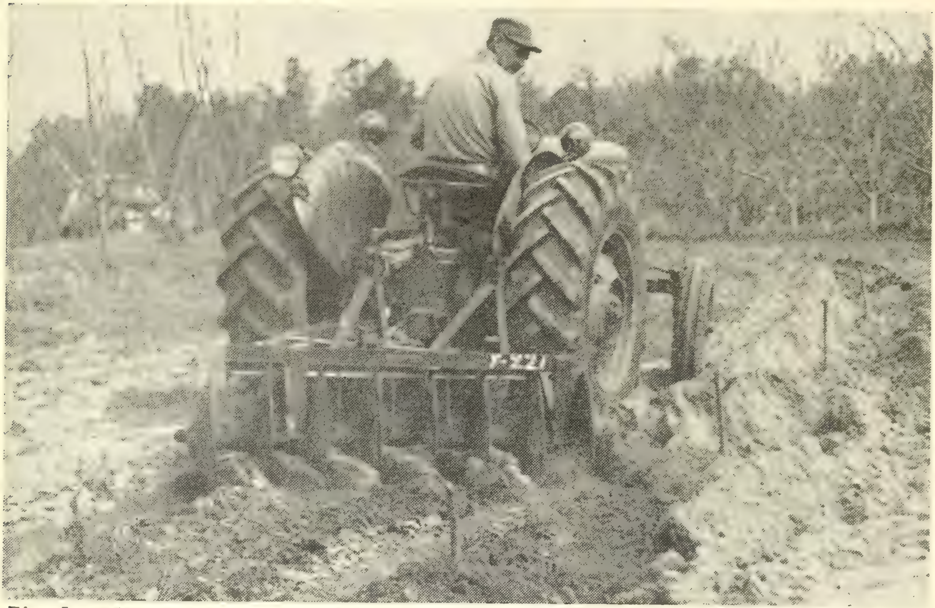

Fig. 5. After the trees are set in place, the trench is simply filled by using a one-way disc tiller and making a complete round to the row.

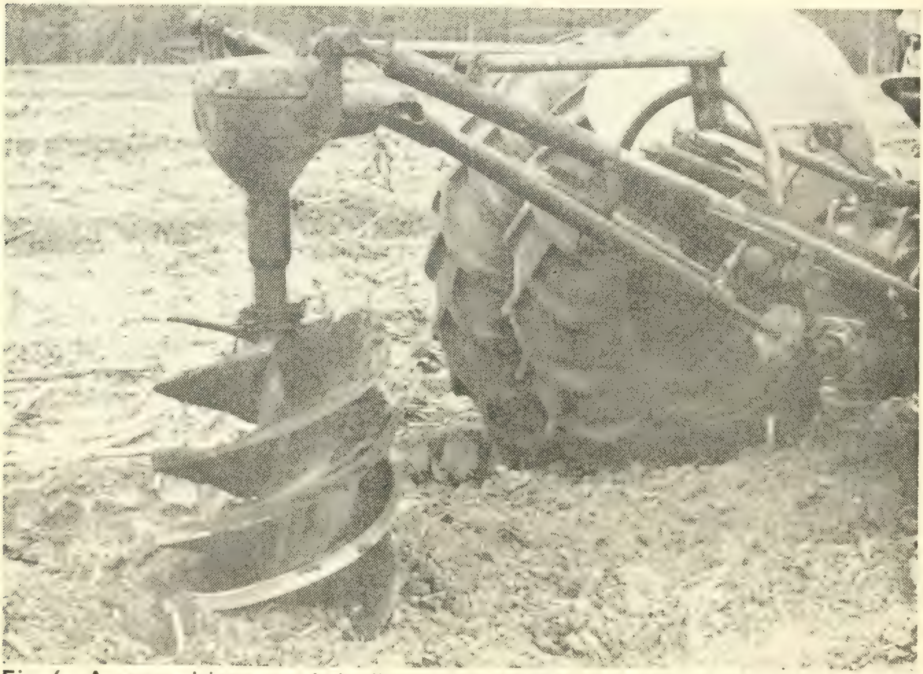

Fig. 6. A power driven post hole digger with an 18-inch diameter auger may be used to plant trees in skips of an old orchard or to fill in wide spaces in an established planting.

Fertilization

In a newly planted orchard or in a young orchard where one cannot be sure that the root system of trees are interlaced along the row, the fertilizer should be applied by hand to each individual tree on an area approximately corresponding with the spread of the root system but never closer than 9 inches of the trunk of the tree.

By the time the trees are old enough to produce a crop of fruit, their root systems will be interlaced in the row, and fertilizer may be applied mechanically. If a complete fertilizer mixture is applied the following method may be used. A two-wheel lime or fertilizer spreader is pulled along the row close to the trees so that one-half of the spreader extends up under the tree branches. The other half of the spreader is closed off by putting a partition in the center of the hopper or by closing off the outlets. Thus the fertilizer is applied continuously in a band, the outer edge of which comes just under the tips of the branches, see Figure 7.

A simple method of calibrating a fertilizer spreader is as follows: (1) Determine the amount of fertilizer to be applied per acre; (2) determine number of trees per acre; (3) determine the number of trees in 100 linear feet of tree row; (4) apply the following formula:

Fertilizer applied in a band under the branches of the tree affords a uniform distribution to the area where the concentration of feeding roots is at a maximum. This promotes effective utilization of applied nutrients. When fertilizer is applied by hand it is often times thrown down in piles or on small areas under the trees; this not only limits the uptake of nutrients but may tend to cause the feeder roots to concentrate in a small area and thereby limit the supply of moisture during a drought. Furthermore, the mechanical application of fertilizer is less expensive than hand application.

The type of soil management employed in the orchard will determine the method and time of application of the fertilizer. For example, in a bearing orchard where winter cover crops are used, such as crimson clover, the phosphorous and potash may be applied at the seeding time of the cover crop in quantities that will be sufficient to supply the trees with the required amounts of these elements during the next growing season. This rate of application of the phosphorous and potash will no doubt be higher than is necessary at the time for a good growth of the legume, but it permits one application of minerals per year to the soil to suffice for both cover crop and trees. Soon after the cover crop

HOW TO CALIBRATE FERTILIZER SPREADER

$$\frac{\text{lbs. fert. per acre}}{\text{trees per acre}} \times \frac{\text{trees per 100 ft. of row}}{2} = \text{lbs. fert. for one side of 100 ft. row}$$

For example, to apply 120 pounds of nitrogen per acre when trees are spaced 20 feet apart in the row and the total number of trees per acre is 80:

$$\frac{120\ (\text{lbs. per acre})}{80\ (\text{trees per acre})} \times \frac{5\ (\text{trees in 100 ft. row})}{2} = 3.75$$

Therefore, the spreader should be set to deliver 3.75 pounds of nitrogen to one side of 100 foot of tree row. While the spreader is calibrated for one side of the tree row, a complete round must be made in order to apply the desired amount per acre.

is turned under in the spring the nutrients are released for use of the trees.

In older orchards where the tree roots are feeding across the middles, the fertilier may be applied from tree row to tree row with a two-wheel spreader or with a truck spreader (Figs. 7 and 8).

Nitrogen is applied in the spring of the year and generally in a continuous band beneath the tree limbs. If a solid form is used, such as ammonium nitrate (33% N), a spreader of the type previously described may be used. If anhydrous ammonia is used, an applicator of the type shown in Figure 9 is required. It has been found that when 100 pounds or less of actual nitrogen per acre is applied in a tung orchard, two injector blades per applicator will do a satisfactory job of sealing the ammonia in the soil. However, when the rate of application is increased above 100 pounds of actual nitrogen per acre, three or more injector blades should be used on the applicator, thus reducing the back pressure and the ammonia applied through each injector blade to an amount that will be satisfactorily sealed in the soil.

The two most important factors to be considered in applying anhydrous ammonia in tung orchards are: sealing the ammonia in the soil with a minimum of loss, and obtaining a uniform flow of the ammonia at a rate that is desired in a tung orchard (50 to 225 pounds of actual nitrogen per acre).

The type of injector blade shown in Figure 10 is very satisfactory for high rates of application. The blade, which has a triangular base, is equipped with a 1/8 inch standard black pipe which is welded to the back edge of the shank

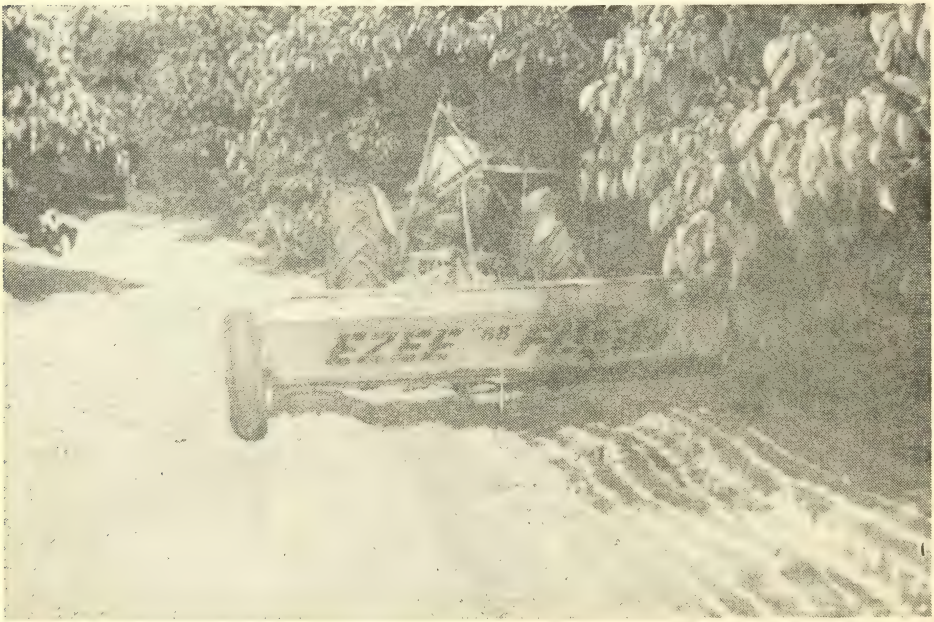

Fig. 7. Fertilizer is easily applied in a continuous band under the drop of the branches by using a two wheel spreader that is pulled close to the trees so that one-half of the spreader extends beneath the tree branches. The outside half of the spreader is closed off by use of a partition or closing the outlets. Note the bands of fertilizer under the trees.

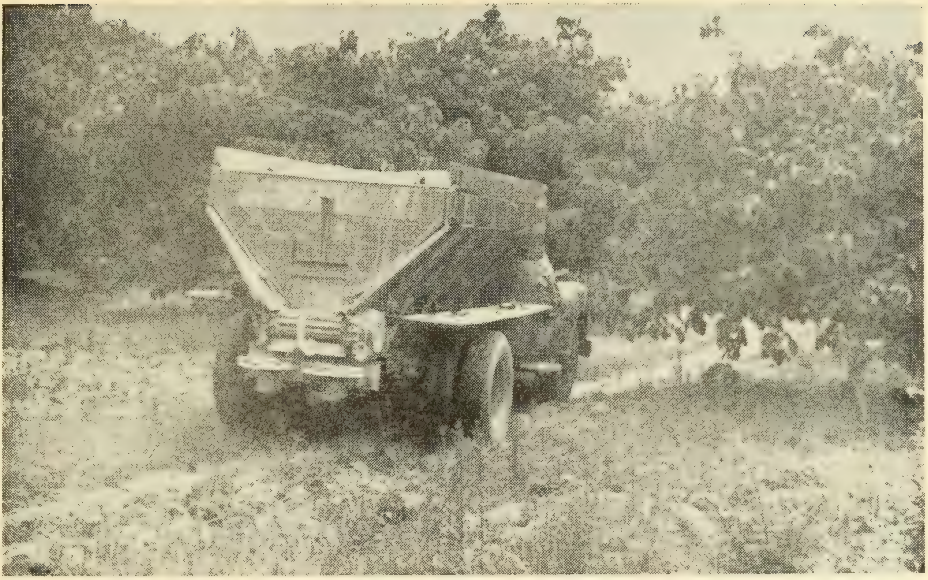

Fig. 8. Probably the most economical method of applying fertilizer is by use of a spreader truck where it is adapted to orchard conditions such as wide middles in old orchards and where the tree roots are interlacing.

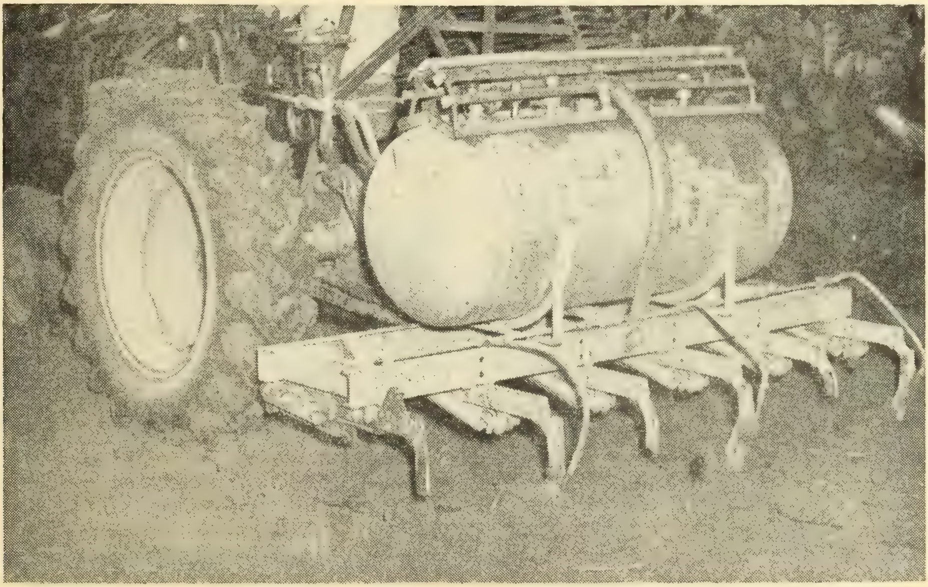

Fig. 9. Anhydrous ammonia applicator mounted on a tractor. It is easily maneuverable in the orchard. When 100 lbs. of actual nitrogen per acre is applied, three or more injector blades should be used. Note the metering pump is mounted on the tractor and is driven from the tractor wheel. Notice that the above applicator will accomodate 6 injector blades that are spaced on 16-inch centers giving an 8 foot swath for pasture and small grain work.

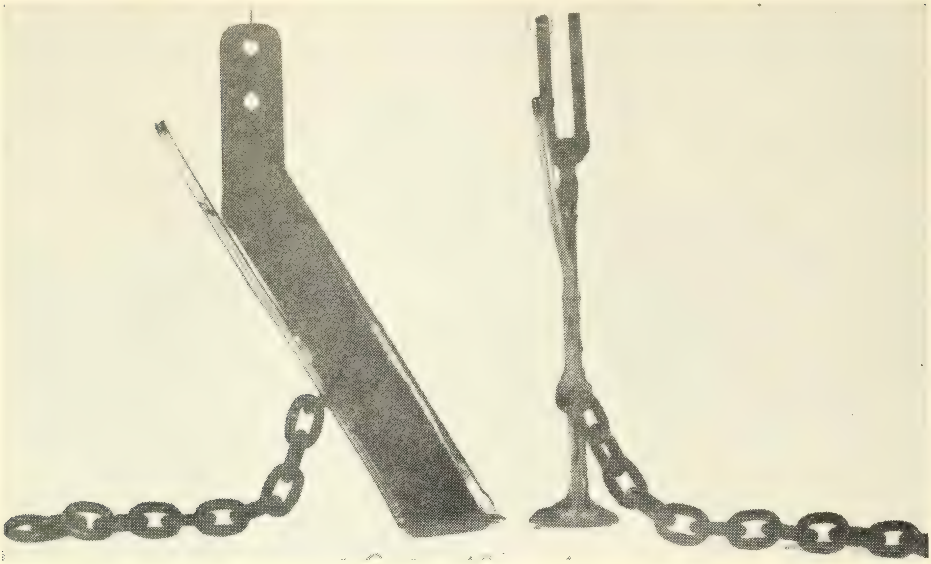

Fig. 10. A most satisfactory type of injector blade for a high rate of nitrogen application is shown. The triangular base opens a channel 4 to 6 inches below the surface for the ammonia to expand into. The section of log chain following behind the blade seals off the escape of the ammonia.

with a "T" at the bottom end of the pipe behind the triangular base. The triangular base opens a channel from 4 to 6 inches below the surface into which the compressed ammonia expands. A piece of 3/8 inch log chain approximately 10 inches long is attached 4 inches above the triangular base. The chain following the blade through the soil seals off the silt in the soil and prevents escape of the ammonia.

The most uniform and accurate method of regulating the flow of ammonia from the tank to the soil is by using a positive displacement ammonia pump. The most satisfactory ways of driving the pump are from the ground wheel of the applicator or the drive wheel of the tractor. Thus, varying forward speeds of the tractor will have no effect upon the rate of application. This greatly simplifies application of anhydrous ammonia in a tung orchard. When the pump has been set for the rate desired as determined by the calibration formula, any tractor driver can operate the applicator accurately.[3]

Aqua ammonia (about 26% N) is also used as a source of nitrogen in tung orchards. An applicator, such as that shown in Figure 11, is used to apply this material. Aqua ammonia does not generate high pressures in storage or handling and therefore may be metered out through the applicator by the use of a small rotary pump driven in a manner similar to that described above for the anhydrous ammonia pump.

In orchards where no cover crops are grown the minerals (phosphorous and potash) can be applied in February and disked into the soil.

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[3] "Metering Pump Improves Accuracy of Anhydrous Ammonia Application in Tung Orchards" by R. E. Jezek and W. W. Kilby. Annual Proceedings of American Tung Oil Association, pp. 16-22.

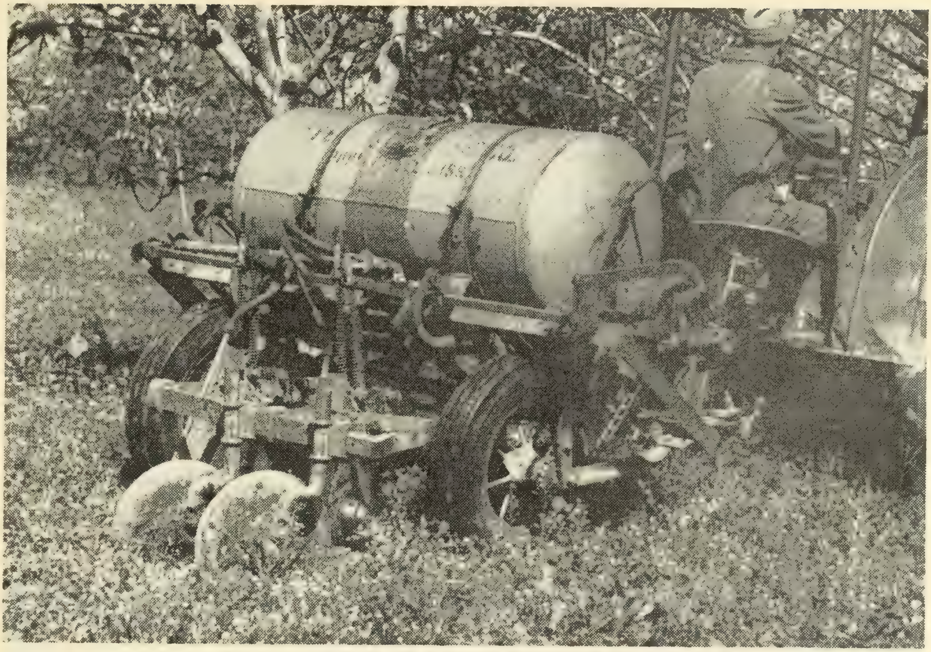

Fig. 11. Aqua ammonia (about 26% N) is also used as a source of nitrogen in tung orchards. It is applied in a small furrow and immediately covered. The aqua applicator has a rotary metering pump which is driven from the ground wheel.

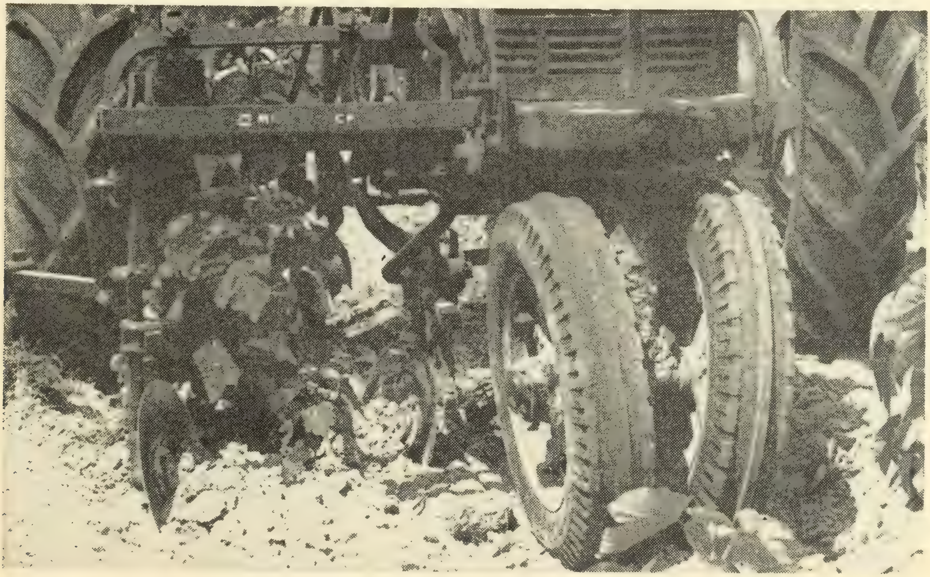

Fig. 12. Row crop cultivating equipment, shown above, works very well in a tung nursery. The use of disc tillers at the time of the last cultivation will cover up grass that may be in the tree row.

Cultivation

Cultivation in the Nursery

A tung nursery should be planted in rows that are laid off by a tractor which will be used to cultivate the trees. Any row crop cultivating equipment may be used to keep the nursery clean. When making the last cultivation with the tractor and row crop equipment, disc hillers should be used to slightly hill up the trees and cover up any grass that may be in the tree row, see Figure 12. The need for and the response of the trees to cultivation in the nursery and young orchards cannot be over emphasized. All grass and other weeds must be kept away from young trees for most satisfactory growth.

Cultivation in a New Orchard

Newly planted trees may be cultivated with row crop equipment such as described for the nursery cultivation, until the trees become too large to allow the tractor to pass over them without causing breakage. Trees usually need two cultivations with a one-way disc tiller after the last cultivation with row crop equipment. This will build a low terrace along the tree row, upon which a broad base terrace may eventually be formed through subsequent cultivation with the one-way disc tiller. Should the grass and weed growth become too rank to be controlled by the disc tiller it is recommended that the trees be hand hoed before the last cultivation with the disc

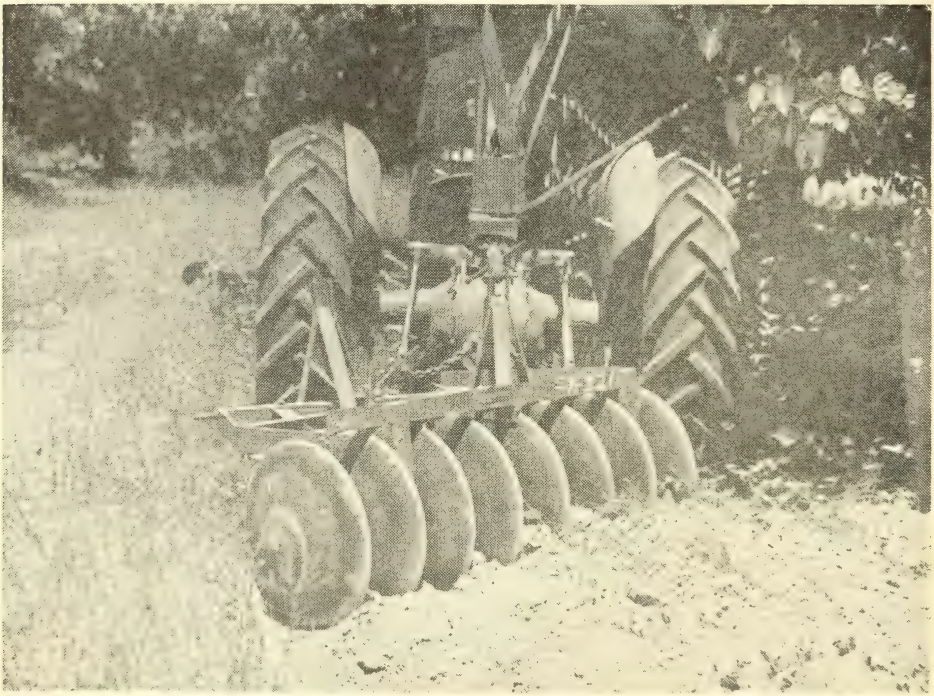

Fig. 13. One-way disc tiller turning under the cover crop. The tiller also helps to maintain the tree row terrace. Note the hitch at the left side of the tiller for offsetting it to make the first round under the tree branches.

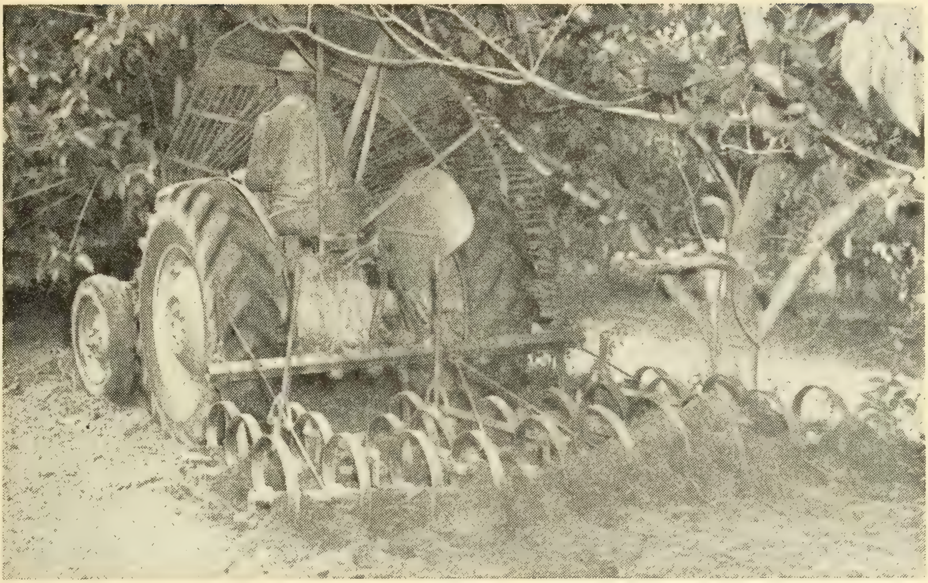

Fig. 14. The spring tooth harrow is effective in controlling the growth of grass and weeds. It should be used as soon as necessary after the first disking to control the grass and weeds. If the growth becomes too rank the harrow will not do an effecfective job.

tiller. Areas about trees must be kept free of weeds for satisfactory tree growth. The middles between tree rows should be left in the native sod or planted to a row crop such as corn, sorghum, soybeans, or a legume cover crop.

During each succeeding year up to the fourth or fifth season of cultivation, the base of the terrace should be broadened and the cultivated strip along the tree row increased to accommodate the growth of the trees. The height of the terrace should not be increased very much after the second cultivating season. This procedure allows the tung orchardist to establish broad based tree row terraces incidental to necessary cultivation, and at no additional cost for the terrace construction.

Cultivation in Old Orchards

Cultivation in old bearing orchards will be governed by the cover crop grown which in most cases is a winter leguminous crop such as crimson clover, vetch, winter peas, etc. It is advisable to plant summer cover crops only in young orchards or in older orchards that have a wide spacing between rows. As the trees grow large they shade the middles and prevent a satisfactory growth of a summer cover crop.

Where a winter cover crop is grown, spring cultivation does not begin until the cover crop has matured seed (about May 10). At this time the cover crop is turned under with a one-way disc tiller. This disking also helps to maintain the tree row terrace. This operation is followed in two or three weeks by cultivating with a spring tooth harrow, or as soon as necessary to control growth of grass, briars, and other competing weeds. The spring tooth harrow operation should be repeated as often as is necessary until the first of July.

When mechanical harvesting is planned for the tung crop, the land under the trees should be levelled following the last spring tooth harrowing. This is especially recommended for orchards that are planted with the low headed varieties, such as Isabel (L-2) and Lampton (F-578).

When there is a growth of grass and weeds in the orchard in July and August that will hinder the harvesting of the tung crop and establishing a stand of a reseeding cover crop, the orchard should be disked in preparation for the harvest and to prepare a seedbed for the cover crop.

If a summer cover crop is grown, the orchard should be cultivated in February with a disc tiller. This will provide a clean firm surface to the soil during the latter part of March, the most susceptible period for cold damage to the bloom. If the soil is clean and firm it will absorb more heat during the day and thereby have more heat to radiate off during the cold night, thus giving some protection from frost damage.

When the weeds, grass and other vegetation begin to grow in the spring, a spring tooth harrow should be used as often as necessary to control weed growth until about June when the cover crop is seeded. In late August and early September the cover crop is either mowed or turned under along the tree row and the ground levelled in preparation for the harvest.

Where the orchard is not fenced or for other reasons no cover crops are grown, the cultivation program and implements used are the same as that described for orchards where summer cover crops are grown.

Harvesting

Tung fruit begin to fall to the ground about the last of September and are left on the ground until they dry down to about 30% moisture. Up to the present time the crop has been harvested by hand labor. The pickers are paid by the bushel.

After the fruit is picked it is handled in one of three ways: (1) Put in burlap bags which are placed in the crotches of the trees for further drying before delivery to the mill, (2) dumped into wagons and hauled to bulk farm storage bins for further drying before being hulled or delivered to the mill, (3) dumped into wagons or trucks and hauled directly to the mill.

There are many variable factors entering into the overall cost of harvesting. These factors are: (1) Transporting the pickers from the rural areas and small towns to the orchards, (2) supervising the pickers, (3) emptying the pickers' baskets into bags and placing them in the trees to dry, (4) ramping fruit from the orchard to a storage shed or to a central loading point in the orchard for delivery to the mill, (5) and finally hauling the fruit to the mill. None of these costs will be the same for all tung orchards. For example, a contractor doing custom harvesting when setting a price for harvesting and delivering a ton of fruit to the mill will consider the following variables: (1) Distance pickers have to be transported, (2) condition of the orchard and the yield per acre, which will affect the number of bushels a picker can harvest in a day and also the cost of ramping the fruit out of the orchard; (3) the cost of hauling the fruit to the mill which will vary with the distance.

Harvest costs that vary from $17.00 to $21.00 per ton delivered to the mill, have been reported. In a very few cases, the fruit is stored and hulled in the orchard. This method of handling the fruit seems to be practical only in large orchards where the volume of crop would justify a home owned huller and the gravity separator necessary to reduce the oil loss in the hulling operation.

The above described procedures for harvesting are those that have been used

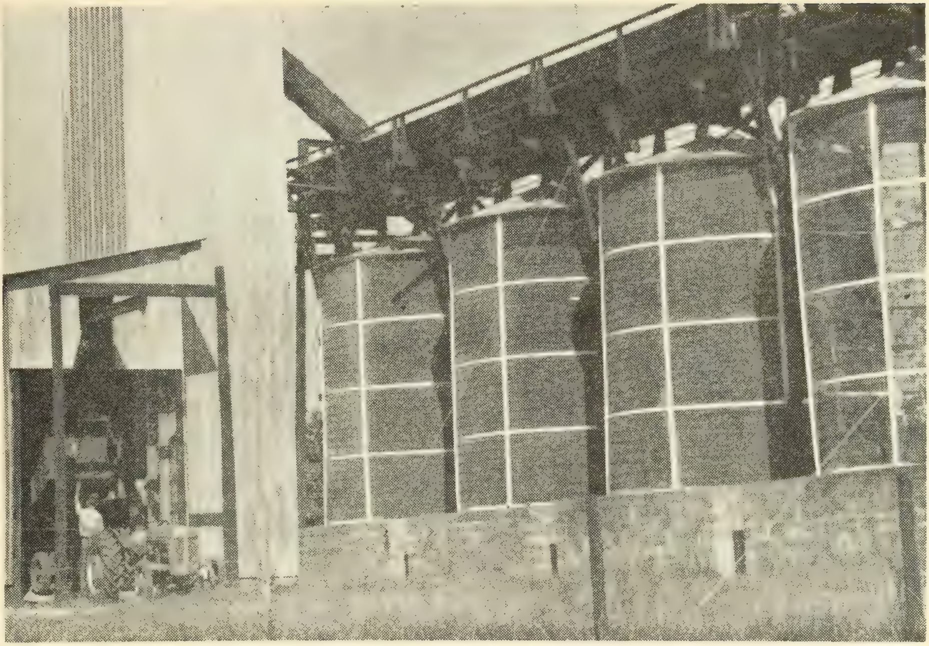

Fig. 15. Tung storage on the farm is shown with a pit-type elevator. Overhead conveyors carry the fruit to the storage bins. The bins are emptied into conveyors that carry the fruit to the huller or truck. Note the field wagon being dumped with an electric driven chain hoist.

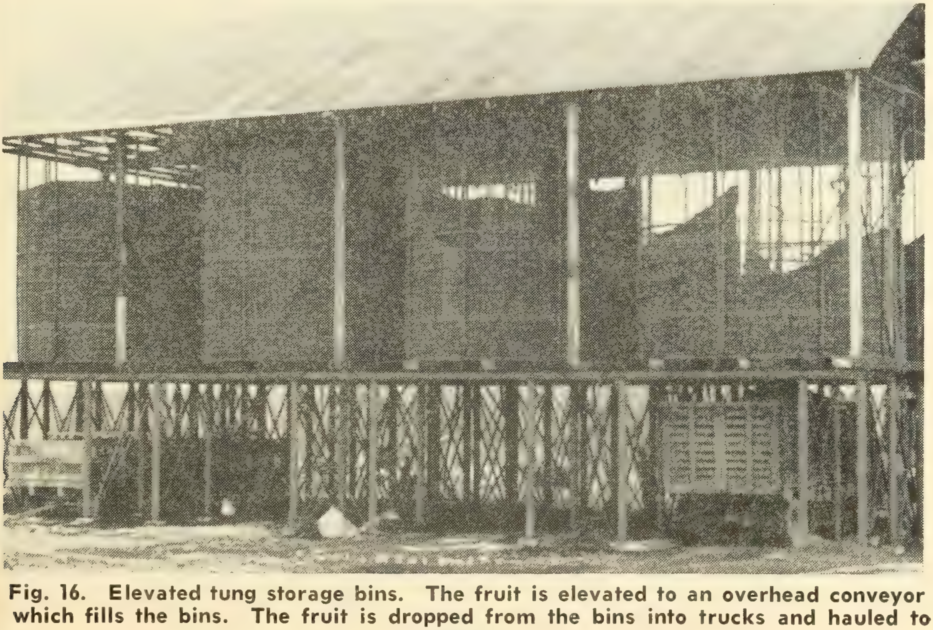

Fig. 16. Elevated tung storage bins. The fruit is elevated to an overhead conveyor which fills the bins. The fruit is dropped from the bins into trucks and hauled to the mill.

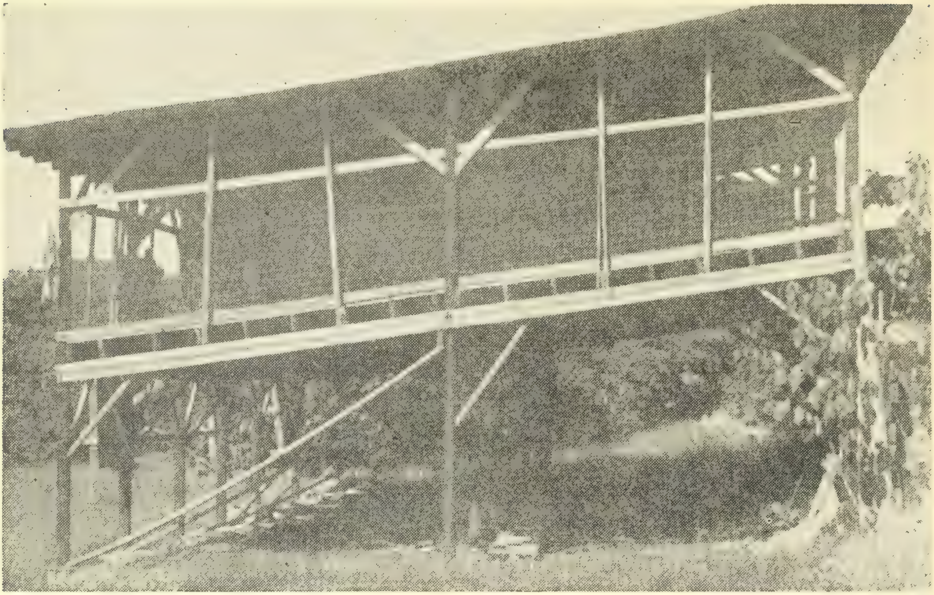

Fig. 17. Tung fruit storage bin built on the farm. This pole storage bin can be constructed for approximately $1000. Its capacity for whole fruit is 100 tons. It also provides additional storage space or shelter for cattle. The fruit is dumped into the upper side and allowed to roll to the lower side by gravity where trap doors may be opened for loading trucks.

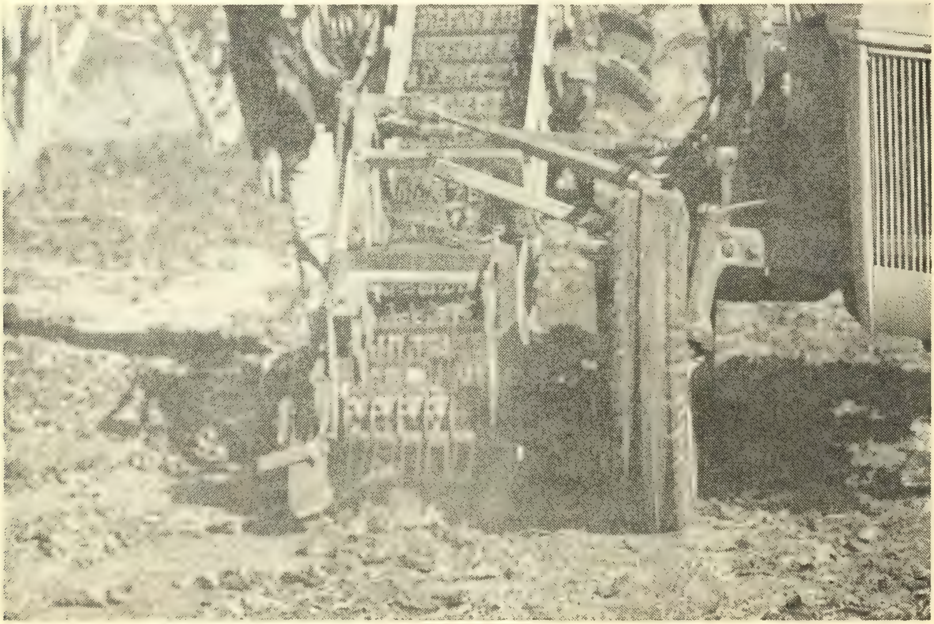

Fig. 18. A model of the endless belt with steel fingers attached, which does a satisfactory job of picking up tung fruit from a windrow.

in the past, all of which require hand labor for picking the fruit from the ground. This is the most costly factor involved in harvesting and therefore has received special attention from research workers and interested private individuals during the past ten years.

Many ideas and principles involved in harvesting nut crops from the ground have been tried in tung with little or very limited success. It was finally concluded that any mechanical harvester to be used in a tung orchard must be relatively small, compact and easily maneuvered through a contour planting. To have these features and also a capacity of 20-30 tons of fruit per day, it was found necessary to sweep the fruit into a windrow.

In 1952 a new principle of picking the fruit mechanically from a windrow was tried and found satisfactory. A full scale harvester was built in 1953. The principle involves an endless flexible metal belt to which are attached crossbars with steel fingers spaced approximately 1½ inches apart. The steel fingers penetrate the soil and do a very effective job of picking up the windrow, see Figure 19. The width of the pick-up belt is 3 feet and the harvester is pulled behind the tractor, which straddles the windrow of fruit made by the brushes mounted in front of the tractor.

The pick-up belt drops the fruit into an elevator which in turn drops the fruit into a trailer pulled behind the harvester. At the point where the fruit is dropped from the pick-up belt to the elevator, leaves and other light material are removed by a fan.

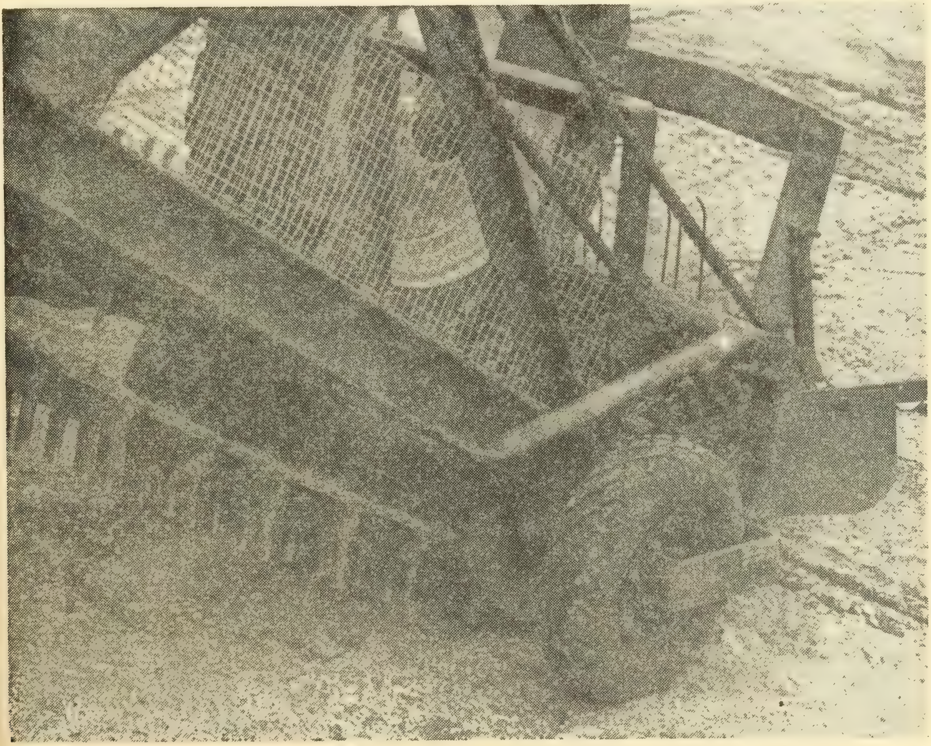

Fig. 19. This shows the steel fingers attached to the endless belt. The fingers penetrate the soil to remove those fruit that may be partially buried.

No tests were made with the experimental harvester to determine its capacity. In 1954 a commercial harvester was tested. Data (See Table 2) showed that the harvester could pick up 95% of the crop when the fruit was raked from the immediate tree row into the path of the windrowing brushes. Eighty-three percent of the crop was picked up where the fruit was not raked from the immediate tree row.

For the harvester to operate at the above described efficiency, the land surface must be relatively smooth so that the fruit may be swept from a 10-foot swath to a 30-inch windrow. The levelling operation should follow the last cultivation in the summer or the cover crop seed bed preparation in the fall. This may be done by the use of several different types of equipment as shown in Figures 21, 22, and 23.

Table 2. Tung harvesting field test.[1]

Seedling trees spaced 20 x 40 feet in straight rows, 54 trees per acre. Test plot; 10 consecutive trees. Field conditions; smooth ground and leaves all off trees.

	Fruit raked from tree row[2]	Fruit not raked from tree row
Fruit harvested by machine, net lbs.	844.0	655.45
Fruit left behind harvester — lbs.	38.8	39.7
Fruit left in tree row — lbs.	0	92.5
Total yield for plot — lbs.	882.8	787.65
Forward speed of harvester — m.p.h.	1.61	1.56
Total yield — per acre — tons	2.4	2.1
Harvester efficiency on area covered by machine — percent	95.5	94.3
Harvester efficiency on total tree area — percent	95.5	83.0

[1] Tung harvesting field test data taken from publication entitled "Tung Harvester Developed Through Research" by R. E. Jezek, W. W. Kilby, and Edgar Jones; Mississippi Farm Research, Vol. 18, No. 3, March, 1955.

[2] Labor required to rake the fruit out of the tree row into the path of the harvester was approximately 2 man hours per acre.

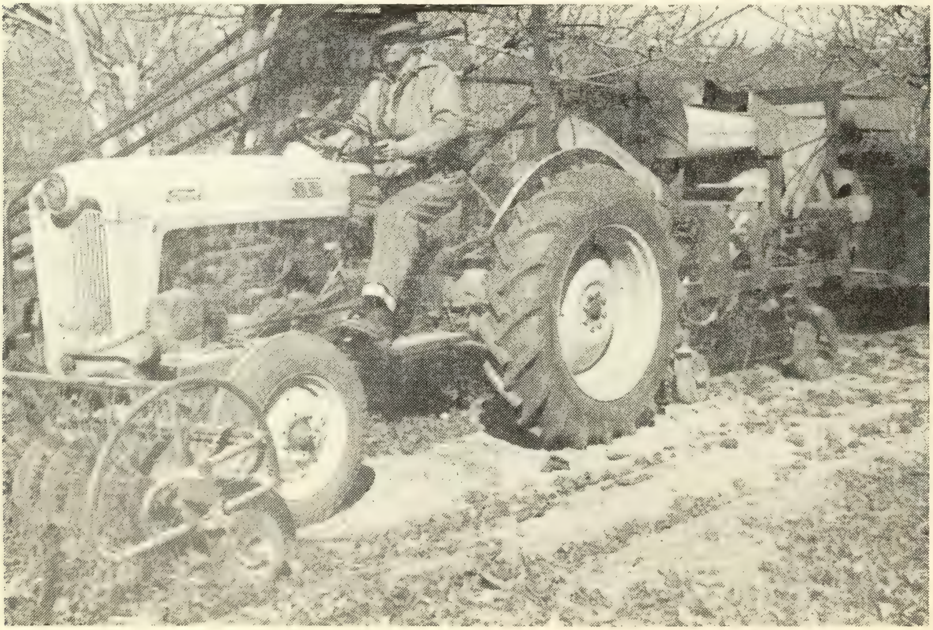

Fig. 20. A commercial harvester shown windrowing the fruit, picking them up, cleaning and placing them in a trailer attached.

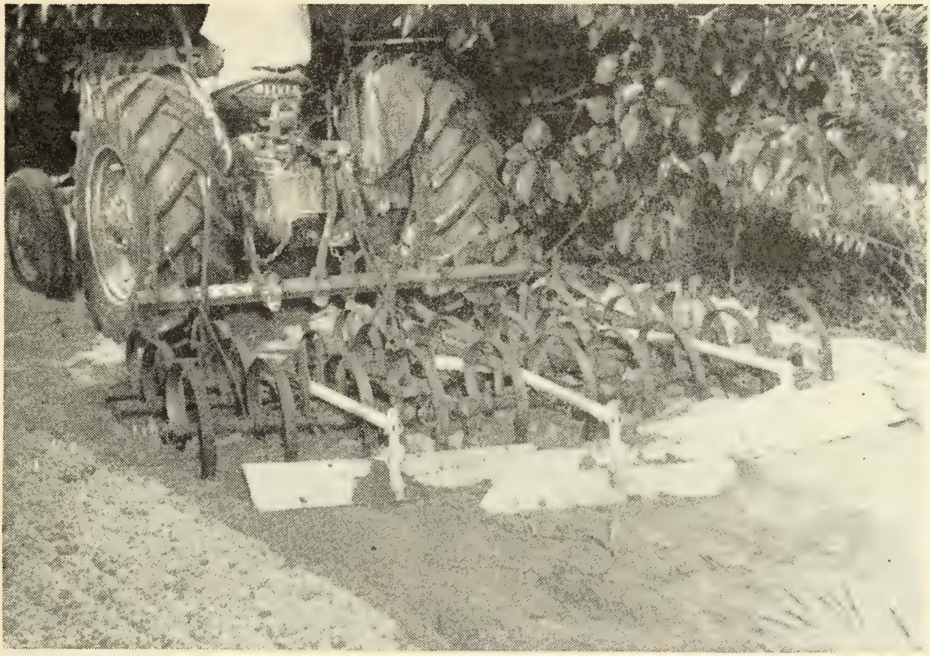

Fig. 21. Levelling blades attached to a conventional spring tooth harrow. A good job of cultivation is done.

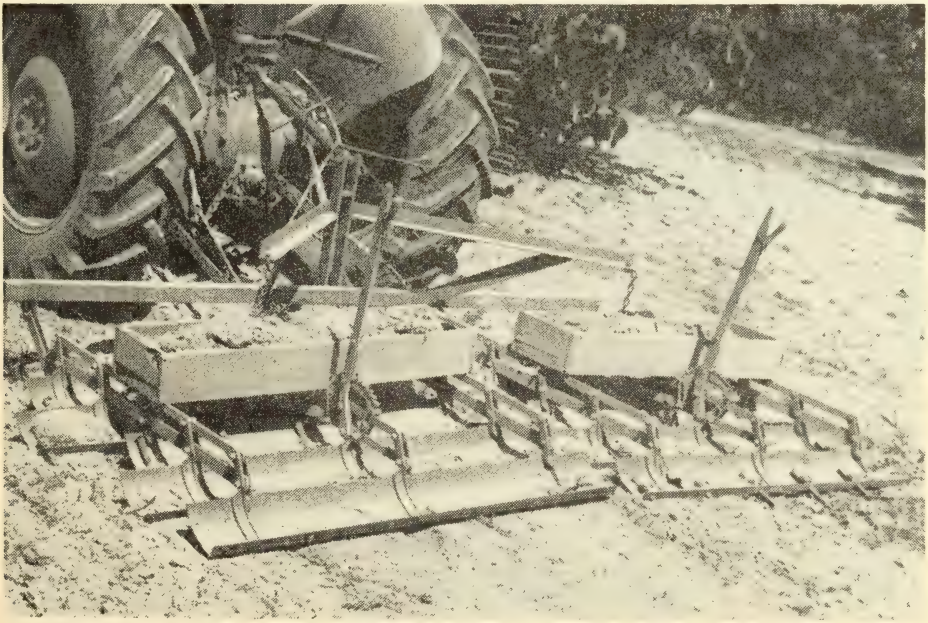

Fig. 22. A soil leveller with adjustable blades is shown above. The spikes attached to each of the blades help to break up the lumps of soil.

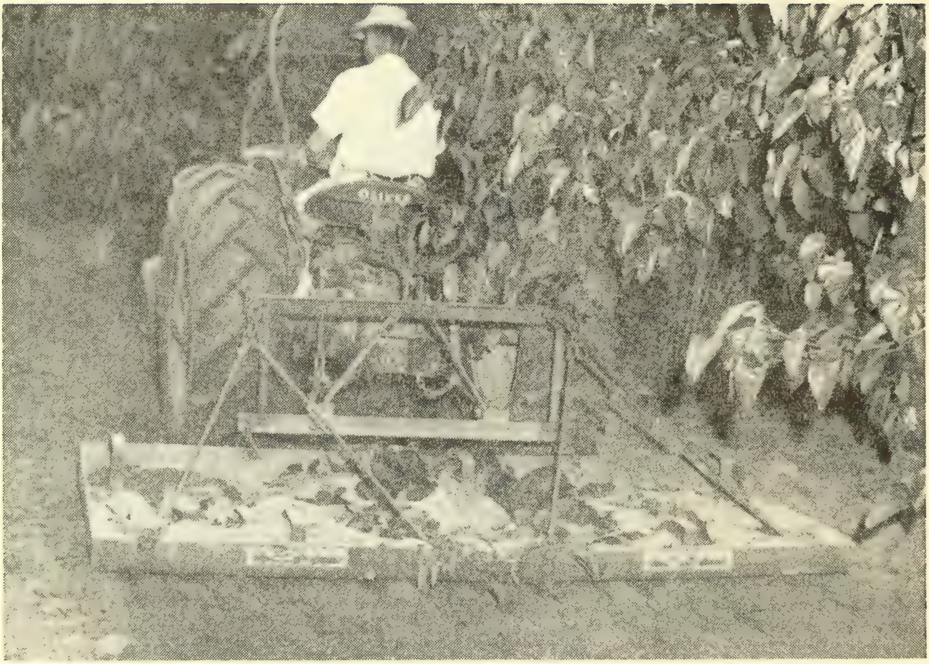

Fig. 23. This shows a levelling implement that is made of two iron pans. To the bottom of each pan are attached blades. The blades are in pairs and are spaced to slice the soil in strips 1-5/8 in. wide. The blades have a tendency to force the loose trash down into the soil.

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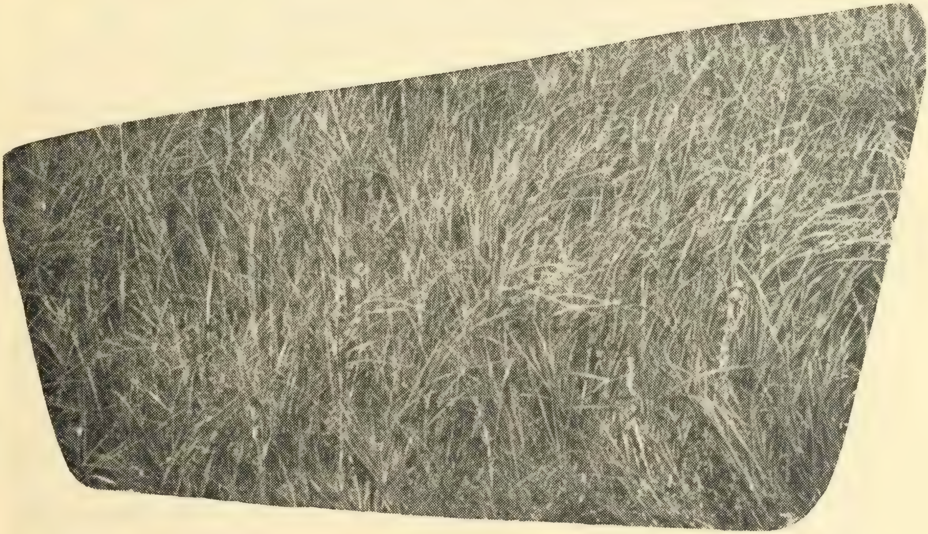
Coastal Bermuda Grass



In Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

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Recommendations

If Coastal Bermuda grass is to be sprigged on a large area several things should be considered.

1. A small area of one-half acre or more should be established for a nursery so that live sprigs for future plantings can be dug and planted immediately.

Home grown sprigs are the cheapest source of planting material and are more likely to survive.

2. The sprigs should be planted in moist soil that has been well prepared as for row crops.

3. The sprigs used should be freshly dug. If possible they should be planted the same day they are dug.

4. A small portion of the sprig should be left above the soil surface.

5. Moist soil should be pressed around each sprig.

6. The Coastal Bermuda should be fertilized as soon as it begins to grow.

7. Weeds and grass should be controlled to prevent crowding out before the Coastal becomes established.

8. Plenty of sprigs should be planted so stolons that did not survive would leave only small skips.

The best time to plant bermuda is in the early spring after all danger of frost has gone, however, most any time during the spring or summer is satisfactory provided the soil is wet for several days after planting. There are many ways of planting bermuda stolons. They can be planted by hand in much the same way as sweet potatoes. Other hand plantings include various methods of making openings in the soil with plows and hand dropping in the furrow. Various mechanical devices such as tree planters, tobacco planters and some vegetable planters may be successfully used. Some commercial companies have a bermuda grass planting machine that does a satisfactory job, however, the machine is very expensive and unless an unusually large acreage is to be planted the cost of this machine would not be justified.

Regardless of the method of planting a minimum of 5,000 sprigs per acre should be used. The more sprigs used per acre the quicker the pasture can be put to use.

Care of Coastal Bermuda pasture will take better management practices than are often given Common Bermuda. It is possible to kill or severely damage the stand by prolonged periods of over grazing or renovation. It is equally hazardous to the stand to allow dense growth of weeds and annual grasses to grow unchecked on the area. If the expense of establishing a Coastal Bermuda pasture is incurred, care should be taken to prolong the productive life of the pasture or meadow. With proper care a good Coastal Bermuda grass pasture will last indefinitely.

COASTAL BERMUDA GRASS IN MISSISSIPPI

By ROBERT E. COATS

Coastal Bermuda grass has been widely publicized in the South during the past few years as a superior pasture grass to Common Bermuda, Dallis grass, and to most other permanent pasture grasses. Phenomenal forage yields have been accredited to this wonder grass. Several hay cuttings per season have been harvested from well managed meadows. Reports have been made that livestock prefer Coastal to Common Bermuda grass. In many cases Coastal Bermuda pastures have produced greater beef and milk yields per acre than other permanent pasture grasses.

Coastal Bermuda grass is a hybrid. It was developed in Georgia by crossing Tift Bermuda (a selection of Common Bermuda discovered near Tifton, Georgia) and a tall growing strain from South Africa. Its many outstanding characteristics have caused some research workers and livestock producers to become interested in this relatively new grass as a possible major pasture and hay crop.

In the spring of 1953 an investigation was begun at the Brown Loam Branch Experiment Station to evaluate Coastal Bermuda grass. Objectives were: (1) to compare the characteristics of Coastal and Common Bermuda; (2) to study the compatibility of legumes with these grasses and their subsequent effect; (3) to study the effect of sod seeding on bermuda grass varieties; (4) to study the effects of dates and levels of nitrogen application on yield and seasonal distribution of production; and (5) to compare the production of Dallis grass, Common Bermuda, and Coastal Bermuda with and without nitrogen.

Management practices during the year of establishment included fertilizing all plots of each experiment with equal amounts of complete fertilizer. Weeds and rapid growing annual grasses were mowed so that establishment would not be delayed by shading or excessive crowding.

Nitrogen in April

Test I: An experiment with low rates of nitrogen applied in the spring was studied. The treatments were as follows: (1) check (no nitrogen applied); (2) 30 pounds of N per acre from ammonium nitrate applied in April; and (3) 60 pounds of N per acre from ammonium nitrate in April. The test was established on an upland soil (Calloway silt loam) and arranged in a Randomized Complete Block design with five replications. The Coastal Bermuda was ordered from Tifton, Georgia, and the Common Bermuda sprigs were dug from the Station pastures. Both the Coastal and Common Bermuda grasses were sprigged by hand on well prepared land on the same day. A uniform application of 60 pounds of phosphate and 25 of potash per acre was applied each spring to all plots. The plots were harvested with a small tractor and mower. Green forage weights were taken and dry weight determinations computed.

Results: The summer of 1953 was dry and a ground cover was not obtained until 1954. The Common Bermuda being slower in growth could not be harvested during 1954.

The Coastal plots were in production a full year before Common Bermuda was well enough established for forage yields. The Coastal plots could be distinctly identified at a distance by their lighter green color, larger and more erect growth, and larger leaves and stems.

Coastal Bermuda grass produced more forage than Common Bermuda at all nitrogen levels, Table I. Over a three-year period Coastal Bermuda produced 197 percent more dry forage than Common Bermuda without nitrogen. Thirty pounds of nitrogen applied in April resulted in 130 percent more Coastal Bermuda forage than a comparable treatment to Common Bermuda grass. Fertilizing both grasses with 60 units of nitrogen increased forage yields of Coastal Bermuda 106 percent more than Common Bermuda.

In comparing two years results (1955 and 1956) in Table I the results show Coastal Bermuda to be a much higher forage producing grass than Common after an extra year was allowed for Common Bermuda growth. The two-year average forage yields for 0, 30, and 60 pounds of nitrogen per acre applied in the spring were 128, 99, and 74 percent more respectively for Coastal Bermuda than for Common. Results indicate that as the nitrogen rates are increased the differences in forage yields for the two grasses are decreased.

For the two years 1955 and 1956 forage production of Coastal Bermuda was increased 1938 pounds per acre with 30 pounds of nitrogen and 3998 pounds per acre where 60 units of nitrogen were added. The response of Common Bermuda to nitrogen was also very good. Thirty units of nitrogen increased the yields from 1095 to 2281 pounds per acre or 1186 pounds of dry forage per acre more than plots without nitrogen. Sixty units of nitrogen applied in April increased the yields of Common Bermuda 2657 pounds per acre more than plots that were not nitrated.

Nitrogen in April and July

Test II: Test two was planted at the same time and in the same way as Test I. The nitrogen treatments were: (1) Check (no nitrogen); (2) 30 pounds nitrogen per acre applied in April and 30 pounds nitrogen per acre applied in July; and (3) 60 pounds of nitrogen per acre applied in April and 60 pounds nitrogen per acre applied in July. The test was located on Calloway silt loam and the treatments were replicated four times. The phosphate and potash were applied each spring at the rates of 60 and 25 units of P_2O_5 and K_2O respectively.

Results: The results followed the same general pattern as in Test I. The Coastal Bermuda, because of its more rapid growth, secured a ground cover more quickly and could be harvested one year before the Common Bermuda was well enough established to warrant a harvest.

Splitting the nitrogen into two applications, one in April and one in July, gave a much better distribution of green thrifty forage than in Test I where only one application was made. The yields were good from spring until mid-fall. Production from Coastal Bermuda was approximately double that of Common Bermuda on all treatments.

Over a two-year period (1955 and 1956) without the addition of nitrogen Coastal Bermuda produced an average of 2780 pounds of dry forage per acre compared to 1270 pounds per acre for Common Bermuda, Table II. Thirty units of nitrogen per acre applied in April and again in July increased the dry forage yield of Coastal Bermuda from 2780 to 6715 pounds per acre or an increase of 3935 pounds. The same treatment on Common

Table 1. Forage production of Common and Coastal Bermuda grass with low nitrogen rates.

Treatment	Yield of dry forage 1954	 1955	 1956	Three-year average	2-year av. for 1955 & 1956
			Pounds per acre		
Coastal					
1 Check (no nitrogen)	1395	2894	2109	2133	2501
2 30 pounds N April	1912	4937	3941	3597	4439
3 60 pounds N April	2508	7018	5980	5169	6499
Common					
1 Check (no nitrogen)	—	1296	894	717	1095
2 30 pounds N April	—	2332	2230	1521	2281
3 60 pounds N April	—	3544	3961	2501	3752

Common Bermuda on the left and Coastal Bermuda on the right. Both varieties were nitrated with 60 pounds of nitrogen in April and 60 pounds in July.

Table II. Rates and dates of applying nitrogen to Common and Coastal Bermuda grass for forage production.

Treatment	Yield of dry forage			Three-year average	2-year av. for 1955 & 195
	1954	1955	1956		
	Pounds per acre				
Coastal					
1 Check (no nitrogen)	1652	3419	2141	2404	2780
2 30 lbs. N April and 30 lbs. N July	2781	7132	6298	5404	6715
3 60 lbs. N April and 60 lbs. N July	4145	10,407	11,181	8578	10,794
Common					
1 Check (no nitrogen)	*	1585	955	847	1270
2 30 lbs. N April and 30 lbs. N July	*	3778	3289	2356	3534
3 60 lbs. N April and 60 lbs. N July	*	4526	6157	3561	5342

*Common Bermuda was not large enough to be clipped in 1954.

Bermuda increased the dry forage yield from 1270 to 3534 pounds per acre or an increase of 2264 pounds. Coastal Bermuda with two applications of 30 units of nitrogen produced 90 percent more forage than Common Bermuda with the same fertilizer treatment.

Sixty pounds of nitrogen per acre applied in April and 60 pounds per acre in July increased the yield of Coastal Bermuda forage 8014 pounds per acre more than plots without nitrogen. The same treatment with Common Bermuda produced 3772 pounds of dry forage per acre more than Common Bermuda without nitrogen. Coastal Bermuda grass produced 102 percent more forage than Common Bermuda where both were fertilized in April and in July with 60 units of nitrogen at each application.

High Rates of Nitrogen

Test III: This test included three rates of nitrogen 0, 150 and 200 pounds of nitrogen per acre. The test was treated and managed in the same way as in Test I and II except the nitrogen treatments were made in one application in April.

Results: The high rates of nitrogen produced very high yields of forage from both Coastal and Common Bermuda grass. The difference in yields of Coastal and Common Bermuda, expressed as percentage, was not as great at the higher rates of nitrogen as it was at the low rates. Without nitrogen Coastal Bermuda produced 105 percent more forage than

Common Bermuda, Table III. When 150 pounds of nitrogen per acre was applied, Coastal Bermuda was only 57 percent more productive than Common. Coastal produced 76 percent more dry forage than Common Bermuda when 200 units of nitrogen per acre were applied.

Fertilizing Coastal Bermuda grass with 150 pounds of nitrogen per acre increased the dry forage yield from 3221 to 11,864 pounds per acre, a difference of 8625 pounds. The same treatment applied to Common Bermuda increased the yields from 1570 to 7535 pounds of dry forage per acre, an increase of 5965 pounds. Two hundred pounds of nitrogen per acre produced 13,480 pounds of dry Coastal Bermuda forage and 7650 pounds of Common Bermuda forage per acre. This was an increase of 10,259 pounds of Coastal Bermuda forage and 6080 pounds of Common Bermuda forage per acre more than was produced from Coastal Bermuda and Common Bermuda plots that were not nitrated.

Applying high rates of nitrogen to a permanent pasture grass is not a general practice in Mississippi, however, these exceptionally good forage yields indicate the productive potential of a well managed permanent pasture is far more than is generally realized.

Influence of Legumes

Test IV: In Test IV Wild Winter Peas and White Clover were drilled into a Coastal and Common Bermuda grass sod with a sod seeding machine. This test was conducted to determine the influence of a legume on (1) the length of the productive period, (2) the effect on the grass after the legume was removed or dead, and (3) the difference in yields of Common and Coastal Bermuda grass. The legumes were planted in October and fertilized with 60 units of phosphate and 25 units of potash per acre. No nitrogen was applied to any part of the test. The plots were 10 by 15 feet in size and the treatments were replicated six times.

Results: The Wild Winter Peas came

Table III. High rates of nitrogen for the production of Coastal and Common Bermuda grass forage.

Treatment	Yield of dry forage 1954	1955	1956	Three-year average	2-yr. av. for 1955 & 1956
	Pounds per acre				
Coastal					
Check (no nitrogen)	701	4027	2414	2381	3221
150 lbs. N per acre	3480	12,000	11,727	9069	11,864
200 lbs. N per acre	4021	14,301	12,658	10,327	13,480
Common					
Check (no nitrogen)	*	1742	1403	1048	1570
150 lbs. N per acre	*	7827	7242	5023	7535
200 lbs. N per acre	*	7403	7897	5100	7650

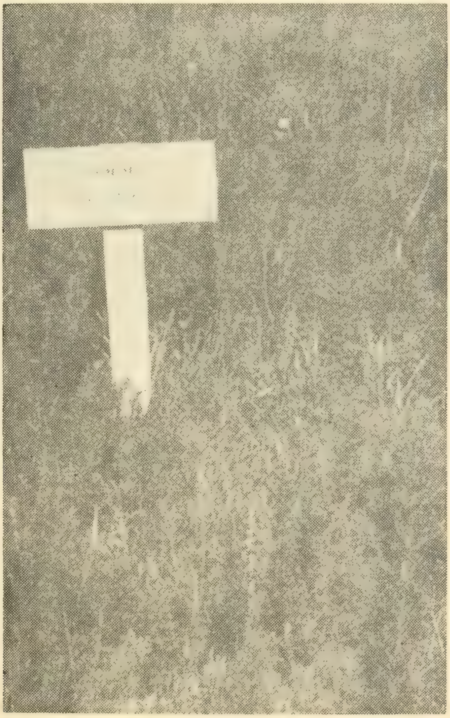
*Common Bermuda not large enough to clip.

Table IV. Common and Coastal Bermuda grass grown without a legume and sod seeded with wild winter peas and white clover.

Treatment	Yield of dry forage 1954	1955	1956	Three-year average	2-year av. for 1955 & 1956
	Pounds per acre				
Costal					
Check (no nitrogen)	1726	3055	2240	2340	2648
Coastal + wild winter peas	2413	7040	7079	5511	7060
Coastal + white clover	1785	3432	2497	2571	2965
Common					
Check (no nitrogen)	—	1131	984	705	1058
Common + wild winter peas	—	5325	5190	3505	5258
Common + white clover	—	1676	1259	978	1468

up to a good stand each year and made satisfactory growth. The White Clover was erratic in stand each season and caused very little increase in forage yields from either Common or Coastal Bermuda. Sod seeding Wild Winter Peas in either Common or Coastal Bermuda increased the production and the productive period of the plots. Over a two-year period Coastal Bermuda without a legume averaged 2648 pounds of dry forage per acre, Table IV. Wild Winter Peas sod seeded in Coastal Bermuda produced 7060 pounds of dry forage per acre. This was an increase of 4412 pounds of dry forage per acre. Sod seeding Wild Winter Peas in Common Bermuda increased the forage production from 1058 to 5258 pounds per acre.

The length of productive period was extended by two to two and one-half months by seeding Wild Winter Peas in either a Common or Coastal Bermuda sod. This extended productive period makes it possible for a bermuda pasture to be grazed for approximately nine months.



Common Bermuda grass without nitrogen severely infested with weeds.

Bermuda grass, both Common and Coastal, was much greener and more productive after the peas were gone than the plots without a legume, indicating the peas had left a considerable quantity of nitrogen in the soil.

Without a legume Coastal Bermuda produced 150 percent more dry forage than Common Bermuda. The Common Bermuda averaged 1058 pounds of dry forage per acre without a legume. The hybrid (Coastal) bermuda produced 2648 pounds of dry forage per acre. The measurable difference between the two grasses was greatly reduced where Wild Winter Peas were interplanted with the grasses. Coastal Bermuda with peas interplanted produced only 34 percent more dry forage than Common Bermuda sod seeded with Wild Winter Peas. This was because the production of peas from the Common and Coastal plots were practically the same. The Coastal Bermuda produced considerably more forage than the Common Bermuda after the Wild Winter Pea forage was harvested.

Dallis Grass and Bermuda

Test V: This test includes Dallis grass, Common Bermuda grass and Coastal Bermuda grass with and without nitrogen. The test was planted in eight by 20-foot plots and each treatment replicated four times. The Common and Coastal Bermuda were sprigged while the Dallis grass was seeded. All entries were planted in the spring of 1954. In order to give all entries ample time to secure a good ground cover and become well established, the test was kept two years before the nitrogen treatments were added. The two years delay was caused by the extremely dry summers of 1954 and 1955. In the spring of 1956 the nitrogen treatment was added to the test. Each of these grasses received one application of 60 pounds of nitrogen per acre in April and again in July. This was compared with similar plots that were not nitrated. Sixty pounds of phosphate and 25 of potash per acre were applied in the spring.

Results: Since there was no rain for eight weeks the crops did not produce maximum yields of forage. Coastal Bermuda with or without nitrogen was superior in forage production to comparable treatment with Dallis grass or Common Bermuda grass, Table V. Without the addition of nitrogen to either grass, Coastal Bermuda produced 1701 pounds more oven dry forage per acre than Common Bermuda and 1630 pounds more oven dry forage per acre than Dallis grass. This increase for Coastal Bermuda was 126 percent more than Common Bermuda and 115 percent more than Dallis grass.

The differences in forage yields where nitrogen was applied were also outstanding. Sixty pounds of nitrogen per acre in April and 60 in July applied to all three grasses produced 6194 pounds more Coastal forage than was produced from the same treatment on Common Bermuda grass. The yields of Coastal Bermuda with nitrogen were 7874 pounds more dry forage than similar treatments on Dallis grass. Coastal Bermuda grass with nitrogen produced 91 percent more dry forage than Common Bermuda and 154 percent more dry forage than Dallis grass.

Even though 1956 was an exceptionally dry year, the response of each grass to nitrogen was very good. Sixty pounds of nitrogen per acre applied in April plus an additional 60 in July increased the production from Coastal Bermuda by 9936 pounds of dry forage per acre. This was a 326 percent increase in Coastal Bermuda forage yields for the addition of nitrogen. Applying nitrogen to Common Bermuda increased forage yield 404 percent. The yield of Common Bermuda was 5443 pounds more dry forage per acre where nitrogen was applied than on comparable plots without nitrogen. Nitrated Dallis grass produced 3692 pounds more dry forage than Dallis grass without nitrogen. The yields from nitrated Dallis grass were 361 percent more than similar plots that were not nitrated.

The nitrated Dallis grass produced most of its forage in the spring and early summer. By June 28 the Dallis grass that was nitrated had produced 229 percent more than was produced from these plots the remainder of the season. The extremely dry summer partially accounted for the small amount of Dallis grass growth after June 28. The yields of Coastal Bermuda were practically the same between June 28 and August 15 as they were up to June 28. The yield of dry forage before June 28 was 6632 pounds per acre. The production between June 28 and August 15 was 6351 pounds per acre which was only a 4 percent difference for Coastal Bermuda.

The Common Bermuda grass forage

Table V. Comparative yields of Coastal Bermuda, Common Bermuda, and Dallis grass with and without nitrogen.

Treatment	Yield of dry forage 1st clipping	 2nd clipping	Yield for season	Dry forage per acre Tons
		Pounds per acre		
Coastal with nitrogen*	6632	6351	12,983	6.49
Coastal without nitrogen	1364	1683	3047	1.52
Common with nitrogen*	2784	4005	6789	3.39
Common without nitrogen	662	684	1346	0.67
Dallisgrass with nitrogen*	3917	1192	5109	2.55
Dallisgrass without nitrogen	784	633	1417	0.71

*Sixty units of nitrogen was applied in April and 60 units added in July.

Note the difference between nitrated Coastal Bermuda on the left and Coastal Bermuda without nitrogen on the right.

produced before June 28 was 30 percent less than was produced between June 28 and August 15. Without nitrogen Coastal Bermuda produced 23 percent more forage after June 28 than was produced before that date. Common Bermuda without nitrogen produced practically the same amount after June 28 as it did before June 28. The yields of Dallis grass with no nitrogen were 24 percent less after June 28 than were produced before that date.

These results indicate that Coastal Bermuda and Common Bermuda are more productive and more dependable pasture crops than Dallis grass during extremely dry periods. Even though the summer of 1956 was extremely dry the growth from the two varieties of bermuda grass was more uniformly distributed throughout the spring and summer growing season.

Discussion

Coastal Bermuda has proven to be superior in many ways to all presently adapted permanent pasture grasses in the Brown Loam Area of Mississippi. Some of the superior characteristics of Coastal Bermuda over Common Bermuda are as follows:

1. It is more erect in growth which lends itself to hay making as well as grazing.
2. The internodes are longer and the leaves, stems, stolons, and rhizomes are larger than Common Bermuda.
3. Coastal is more tolerant to light frost and remains green and in a more thrifty condition later in the fall.
4. The root penetration of Coastal is much deeper than that of Common which insures good growth for Coastal Bermuda during dry weather.
5. It is more disease resistant. Coastal Bermuda is resistant to Helminthosporium leaf spot that often causes the leaves of Common Bermuda to die. It is also resistant to root knot nematode which makes it possible to grow some legumes that are not susceptable to root knot organisms.
6. It will grow and spread faster, and secure a ground cover quicker than Common Bermuda when both are sprigged.
7. The dry weight content is often higher than most other grasses.

8. It is a dependable perennial pasture crop.

9. The forage yields are much higher than Common Bermuda or Dallis grass.

10. The yields appear to be better distributed over a longer portion of the season.

Coastal Bermuda is relatively new in Mississippi forage crops. The hybrid grass has consistantly produced much better forage yields than either Common Bermuda or Dallis grass. It is possible that higher yields can be obtained from all species reported. The yields were produced during three of the driest years on record.

The greatest differences between Common and Coastal Bermuda seem to be where no fertilizer is applied and under low fertility levels. The difference between Common and Coastal Bermuda narrowed as the rate of nitrogen was increased. This is a definite advantage for Coastal Bermuda since most improved pastures are fertilized with only small quantities of fertilizer materials.

Coastal Bermuda is not without fault. Some of the disadvantages are listed as follows:

1. Coastal Bermuda must be propogated vegetatively on a prepared seedbed either by hand or mechanically since it makes practically no seed.

2. Generally, during drouthy years, the first year's grazing on the area is lost or delayed unless irrigation is available. During seasons of ample rainfall a ground cover may be completed the first year.

3. Weeds and annual grasses should be controlled.

Common Bermuda can be seeded and a good ground cover secured the first year. This advantage for Common Bermuda as well as its perennial persistance and presence in practically every pasture and field in the Brown Loam Area cannot be discounted. Greater yields can be realized from presently established Common Bermuda pastures by applying better management practices. It is an expensive operation to completely renovate a pasture that is well covered with a practically adapted perennial grass. However, Coastal Bermuda is a perennial grass that has the same general region of adaptation as Common Bermuda and if properly managed is a good dependable pasture or hay crop.

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ESTIMATED POPULATION TRENDS IN MISSISSIPPI 1950-56

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ESTIMATED POPULATION TRENDS IN MISSISSIPPI, 1950-56

By HARALD A. PEDERSEN and LEILA H. THOMAS

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It is now seven years since the last census of population was completed in the United States. During the intervening years the vital processes — births and deaths — have continued to add and subtract from the total population of the nation. Migration has only a nominal effect on the total population of the United States. Immigration has been reduced by legislation and emigration, the departure of people from the country, has never been very great.

The balance of births over deaths and a nominal net migration have brought the population for the nation to an estimated 170,000,000 people as of February, 1957.

The trend of population growth in the nation has been rather consistent since 1900. The only deviant period is from 1930 to 1940. The declining rate of growth during this period was so significant that the population experts predicted that the population of the United States would stabilize in the neighborhood of 180,000,000 persons about the year 2000. This estimate has been revised upward to 220,000,000 with no indication that this figure is the maximum.

The trend of population growth for the South has kept up with the trend for the nation. The 16 Southern states, in 1956 had 50,809,000 persons.

The growth trend for the State of Mississippi, however, is an entirely different picture. The early period, 1900 to 1910, shows a rate of increase almost equal to that for the South and the nation. Following 1910, however, the population of the state remained almost stable at 1 3/4 million persons. A period of rapid growth began in 1920 and terminated in 1940 when the population of the state was 2,183,000 persons. The population at the last census in 1950 was 2,178,000 people.

The primary factor affecting population change within the state is migration. Migration in Mississippi has been estimated to be of such magnitude that a migrant leaves from one household in six every year. The movement of people is a very important element in the adjustment of people to resources and opportunities. In the United States we have a tradition of mobility. This tradition began with the first immigrants, continued with the westward movement, and survives today as the cityward flight of young people from farms and villages.

Unfortunately, from the standpoint of projecting population growth between census years, there is no record of the movement of people. To determine the effect of movement it is necessary to depend upon data which are assumed to reflect migration into or out of a given area. Changes in enrollment in the second through the eighth grades have been found to be a reliable index of migration and these were used to arrive at an estimate of the current population in Mississippi and of the change which is taking place in the various counties of the state.

Decline in Population

On the basis of our estimates, the white civilian population in the state has decreased from 1,175,000 to 1,124,000 from April 1, 1950 to July 1, 1956. During the same period the nonwhite population has decreased from 989,000 to 960,000. When the military personnel stationed in the state are added to these two figures the state population, as of July 1, 1956, becomes 2,110,000 persons.

The rate of change has not been the same throughout the state. Some parts of the state show large increases, other parts have shown decisive losses. The range in rate of change is from a 35 percent increase in Jackson County to a 29 percent loss in Neshoba County.

When the rates of change in the various counties are grouped into four categories—those with increases, those with no change, those with moderate decreases, and those with large decreases—the majority of the counties show moderate or large decreases. Only eleven counties show an increase in total population during the period 1950-1956. This category includes all counties which have experienced 3 percent or greater increases. Eleven counties have remained relatively stable, i.e. the rate of change has been less than 3 percent increase or decrease. These two categories account for slightly more than one-fourth of the counties in the state. Thirty-two counties have experienced moderate losses, that is, decreased in population from 3 to 10 percent and 28 counties have experienced

Table 1. Rank order of Mississippi counties by percent of change in total population and by race, 1950-1956.

	Total	White	Nonwhite
		Percent	
Increase			
Jackson	35.2	39.2	26.4
Harrison	24.5	14.1	23.9
Hinds	20.1	25.7	13.1
Adams	12.7	19.6	5.8
Hancock	9.9	19.7	—36.9
Washington	8.5	25.3	—4.9
Coahoma	6.5	5.5	7.0
George	5.0	5.2	3.2
Tunica	5.0	12.5	3.3
Pearl River	4.6	2.0	14.2
Jeff. Davis	4.1	—7.6	13.5
Stable			
Panola	2.7	—6.4	9.9
Stone	2.3	—.6	12.7
Yazoo	.8	1.1	.7
Warren	—.4	16.7	—17.1
Grenada	—.6	—3.3	1.9
Forrest	—1.3	.6	—5.8
Lowndes	—1.3	5.9	—9.6
Quitman	—1.6	—8.0	2.5
DeSoto	—2.2	3.9	—5.2
Lee	—2.2	—5.7	7.0
Issaquena	—2.7	18.3	—12.8
Moderate Decreases			
Greene	—3.1	—5.5	8.0
Lauderdale	—3.3	—3.5	—2.8
Sunflower	—3.4	—8.4	—1.0
Sharkey	—3.5	—9.8	—.9
Simpson	—3.5	—10.6	10.9
Benton	—3.6	—13.7	9.5
Tate	—4.3	—10.3	.2
Covington	—4.5	—11.8	11.3
Montgomery	—4.7	—9.9	2.2
Madison	—4.8	—9.4	—3.1
Rankin	—5.0	.8	—11.5
Tippah	—5.2	—8.7	9.4
Marion	—5.5	—14.7	11.7
Claiborne	—6.1	2.4	—9.0
Bolivar	—6.2	—11.3	—3.9
Lincoln	—6.2	—10.7	3.0
Lamar	—6.7	—6.7	—6.7
Tallahatchie	—6.7	—9.8	—4.9
Wilkinson	—6.8	—23.5	.7
Union	—7.4	—10.9	8.4
Alcorn	—7.6	—7.6	—7.6
Humphreys	—7.9	—14.4	—5.1
Walthall	—8.1	—6.4	—10.0
Scott	—8.3	—11.8	—3.7
Pike	—8.4	—11.1	—5.1
Prentiss	—8.4	—9.0	—3.8
Lawrence	—8.6	—12.7	—1.8
Marshall	—8.7	—11.3	—7.6
Wayne	—8.9	—10.1	—6.7
Pontotoc	—9.0	—8.8	—9.2
Chickasaw	—9.3	—6.5	—12.8
Webster	—9.5	—9.7	—8.8
Large Decrease			
Jones	—10.0	—10.6	—8.1
Copiah	—10.1	—12.8	—7.7
Oktibbeha	—10.3	—12.1	—8.4
Jasper	—10.4	—13.0	—7.8
Clarke	—10.5	—12.2	—7.9
Jefferson	—10.9	—15.3	2.5
Leflore	—11.3	—4.4	—14.5
Amite	—12.3	—18.1	—7.4
Winston	—12.4	—14.2	—9.8
Attala	—13.0	—18.2	—6.2
Noxubee	—14.0	—5.7	—16.8
Yalobusha	—14.5	—20.4	—7.0
Choctaw	—14.8	—19.2	—4.8
Clay	—15.1	—.7	—25.9
Holmes	—15.9	—22.5	—13.5
Tishomingo	—16.1	—16.5	—9.9
Newton	—16.3	—24.4	—.9
Carroll	—16.6	—26.9	—8.8
Monroe	—16.9	—16.9	—16.8
Calhoun	—18.0	—25.5	6.6
Smith	—18.2	—17.1	—22.7
Franklin	—19.4	—20.1	—18.3
Itawamba	—21.0	—22.1	—1.2
Perry	—21.0	—24.0	—11.3
Kemper	—25.1	—42.0	—13.5
Leake	—28.3	—34.1	—20.3
Lafayette	—29.0	—44.6	—.4
Neshoba	—29.4	—33.3	—18.0

large losses, or losses of 10 percent or more, in total population (Table 1).

Gains In Industrial Areas

The distribution in the state of the counties in the various rate of change categories reveals a cluster of counties showing increases on the Gulf Coast The increase cluster includes the three coastal counties and two adjoining counties, Pearl River and George. Six of the counties which show increases in population have large urban concentrations. In Jackson County, Pascagoula and Ocean Springs experienced sizeable increases in population during the preceding decade, 1940-1950. The Ingalls Shipyard is again operating near capacity and two or three additional plants have been established or are proposed for the area. In Harrison County, the whole coastal area has been expanding, with Gulfport and Biloxi in particular showing phenominal rates of growth. Hancock County, though it does not have a large urban concentration, has shown a spurt of growth on the basis of our estimates. It is quite likely that this growth is concentrated, as in the other coastal counties, in the narrow strip along the Gulf.

The recent industrial development in Adams County, around Natchez, has contributed to the growth in population in that county as is also the case with Greenville in Washington County, and to a lesser extent with Clarksdale in Coahoma County. The capital city of Jackson has continued its rapid increase of the preceding decade and completely dominates the population picture in Hinds County. The other counties in this group do not have large urban centers and have shown only nominal increases of 5 percent or less.

In the counties with stable populations, large urban centers are also present or nearby. The largest cluster of counties in this group is a group of three counties around Vicksburg, including Warren, Issaquena, and Yazoo. Hattiesburg, Grenada, Tupelo, and Columbus account for the other major cities in the counties showing a stable population.

The mere presence of a progressive and developing urban center is not enough, though, to overcome the exodus of people from the surrounding area and assure the county of an increase in population. Meridian in Lauderdale County and McComb in Pike County have expanded their industrial plants but the county in each case shows a moderate decrease in population.

Some Divergent Trends

The most striking examples of divergent trends, however, are West Point in Clay County, Kosciusko in Attala County, and Greenwood in Leflore County. New industrial establishments of considerable size have been brought to each of these towns, but in each case the counties have experienced large decreases. In West Point, the Babcock and Wilcox Boiler Plant is operating with a payroll of more than 800 people. The Pathfinder Coach Corporation in Koscuisko approaches a similar payroll, and several plants have been opened in Greenwood in the period since 1950. The rate of decrease, however, is 15 percent for Clay County, 13 percent for Attala County, and 11 percent for Leflore County. Another notable exception is Laurel in Jones County where the rate of decrease is 10 percent.

Despite these exceptions, rural counties predominate in the group of counties having large decreases. The counties with large decreases are clustered in the central clay hills stretching northward into the northeast highlands and southward into the coastal plains.

The rate of change was computed separately for the white and non-white population groups. The distribution of counties in the state based on the white and nonwhite rates of change in population for the period 1950 to 1956, reveal that the nonwhite population has experienced a lower rate of change than the white population.

The rates of change for the two racial groups are based on the civilian population. The civilian population in 1950 serves as the base population, and the estimate for 1956 is also an estimate of the civilian population. Since the military personnel stationed in the state has remained relatively constant throughout the period and no major changes have been made in the location of military establishments this will not affect the relative rank of the counties based on the rate of change

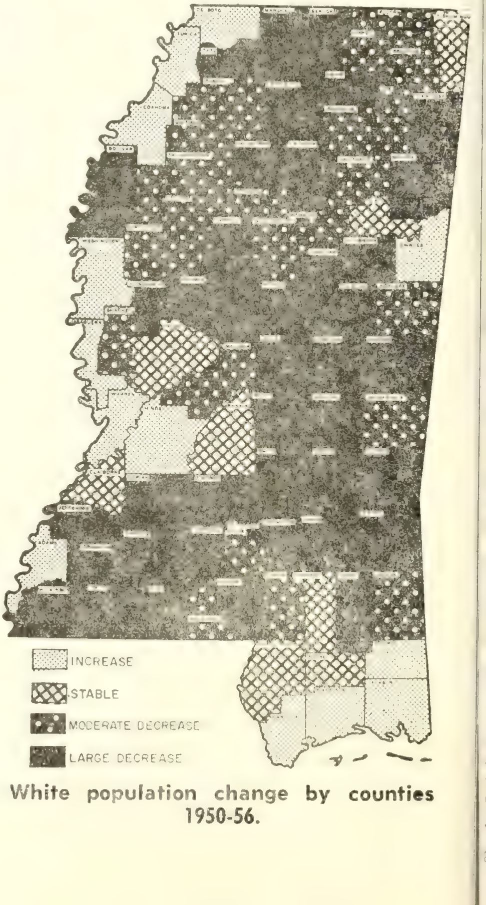
Rate of Change Varies

The rate of change for the nonwhite population ranged from a 23.4 percent increase for Jackson County to a 36.9 percent decrease for Hancock County. For the white population the range is from 39 percent increase in Jackson County to 44.6 percent decrease in Lafayette County. In the distribution of counties by rate of change in the white population thirteen counties show an increase. These 13 counties include nine of the 11 counties which show increases in total population. One of the counties, Pearl River, falls in the group of counties with stable populations when the rate of change for the white population is computed. The other county, Jefferson Davis, shows a moderate decrease in the white population. Four counties, Issaquena, Warren, Lowndes, and DeSoto, were classified as having a stable total population but came into the group of counties showing increases in the white population. There are only eight counties which have stable white populations. Twenty-two counties show moderate decreases and 39 counties show large decreases in the white population.

Turning to the nonwhite population we find that 21 counties show increases. These, likewise, include nine of the 11 counties showing increases in the total population. However, Hancock County drops into the group of large decreases, whereas Washington falls into the group with moderate decreases. For the nonwhite population there are 14 counties showing stable populations, 30 counties showing moderate decreases, and only 17 counties show large decreases.

The data on rates of change may also be summarized in another manner. There are nine counties in which the white population shows an increase whereas the nonwhite population shows a decrease. There are 16 counties where the white population shows a decrease and the nonwhite population shows an increase. Finally, there are 32 counties in which the decrease in the white population is greater than the decrease in the nonwhite population. For the remaining 25 counties the decrease in the nonwhite population is greater than or equal to the decrease in the white population. (Table 1).

In conclusion it should be pointed out



White population change by counties 1950-56.

that while birth and death statistics are accurate the estimates of the rates of change for the counties may be subject to error as far as migration is concerned.

The high birth rate of the immediate post-war period has continued up to the present, and since death rates have remained relatively constant, this means that the state has had a high rate of natural increase. The birth rates for the nonwhite population have consistently been higher than for the white population. Even though the death rates are somewhat higher for the nonwhite population than for the white population, the nonwhite population still has a higher rate of natural increase. If no other factors affected population in the state and in the counties, a considerably higher nonwhite population than the one estimated could be expected.

School Figures Used

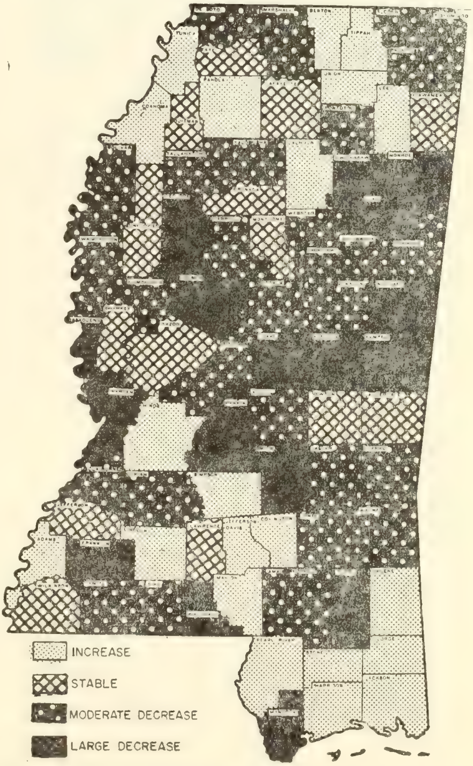
Determining the migration rate necessitated depending on school enrollment, and, using this information, it is essential that some assumptions be made. First, it must be assumed that the ratio of children in school to the children of school age is the same in 1950 as in 1956. The second assumption is that the rate of migration observed among school children has the same relation to the total migration rate for both the white and the nonwhite populations as was observed for the total population for the United States.

One adjustment was made in the procedure, based on the theory that the number of nonwhite children going to school would increase due to an improvement factor, so the nonwhite enrollment in 1956 was adjusted to account for this improvement. This adjustment had the effect of increasing the rate of migration for the nonwhite population.

Despite this adjustment the nonwhite population has experienced a lower net loss than the white population during the period 1950 to 1956. The result is that, whereas in 1950 the nonwhite population accounted for 45.4 percent of the total population, in 1956 the nonwhite population accounts for approximately 46 percent of the total population.

Some other points of possible error with respect to specific counties are in Oktibbeha and Lafayette Counties where the college students are included in the population for the county. The student population is not reflected in the enrollment figure in the elementary school and in these two cases it is likely that totals underestimate the actual population.

The critical factor affecting the population situation in Mississippi is that, despite the sizeable increases in urban centers, Mississippi remans predominantly a rural state. Rural societies have large numbers of children and few vocational opportunities. Therefore, some of the chil



Non-white population change by counties 1950-56.

dren must migrate to find employment. The opportunities for urban and industrial employment in Mississippi are limited. Thus, a considerable number of young people in the state find it necessary to cross the state lines to nearby metropolitan centers.

The migration of people is a necessary and an important factor in the adjustment of people to resources and can be beneficial to both the receiver and the donor state, by supplying needed workers in the former case and by relieving the pressure of people upon the land in the latter instance.

APPENDIX

Methodology

The procedure used in compiling the estimate of the population for Mississippi in 1956 is described by the Bureau of Census as a variation of the "migration and natural increase" method of determining population trends.[1] This method involves the civilian population of the base year of 1950, the natural increase, net civilian migration, net loss to Armed Forces, all for the period 1950 through 1956, estimated civilian population in 1956, and military personnel stationed in the state in 1956.

The distinguishing feature of this method is that net migration is based on school enrollment data, following the assumption that there is a known relationship between the movements of elementary school children and migration of the total population. Since the birth, death, and migration rates for the white and nonwhite populations are different, it was decided to make separate estimates for the two major racial groups in the state.

Civilian Population, 1950

The civilian population in 1950, the latest census year, was the figure upon which the estimates were based. To derive the civilian population, the total population for the county was obtained from the 1950 Census of Population.[2] Then, from the same source, the number of military personnel stationed in the county was determined by finding the difference between the number of persons in the total labor force and the number in the civilian labor force. When the military personnel were subtracted from the total population, the resulting figure was the civilian population for the county in 1950. In the examples illustrating each step, Hinds County will be used.

Civilian population of Hinds County, April 1, 1950	141,991
(a) Total population, April 1, 1950	142,164
(b) Persons 14 and over in labor force, April 1, 1950	59,095
(c) Persons 14 and over in civilian labor force, April 1, 1950	58,922
(d) Military personnel stationed in the county, April 1, 1950 (b-c)	173
(e) Civilian population, April 1, 1950 (a-d)	141,991

Natural Increase

The first factor causing population change is the natural increase. This figure represents the excess of births over deaths during a given period of time. The necessary data was found in the **Annual Bulletin of Vital Statistics,** published by the Mississippi State Board of Health. The births in each county were adjusted for under registration with data from the National Office of Vital Statistics.[3] This birth registration completeness data was not available by race.

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[1] "Population Estimates," **Current Population Reports,** Series P-25, No. 133, Bureau of the Census, March 16, 1956 (Washington, D.C.).

[2] U. S. Bureau of the Census, 1950 Census of Population, Vol. II, **Characteristics of the Population,** Part 24, Mississippi, Table 43.

[3] National Office of Vital Statistics, **Vital Statistics . . . Special Reports,** Vol. 39, No. 4, "Birth Registration Completeness in the United States and Geographic Areas, 1950," Part II, Data for Local Areas, January 20, 1955.

Natural increase in Hinds County, April 1, 1950 to July 1, 1956	20,447
(a) Births, by residence, during period	28,236
(b) Percent completeness of birth registration in Hinds County, 1950	99.1
(c) Births, by residence, adjusted for underenumeration, during period (a÷b)	28,492
(d) Deaths, by residence, during period	8,045
(e) Natural increase during period (c−d)	20,447

Net Civilian Migration

As mentioned previously, migration rates were based on school enrollment data. The migration rate for children 7½ to 14½ years of age was determined by comparing the estimated population for this age group and school enrollment data for grades 2 through 8. The Census Bureau recommended using this age-grade combination because it led to greatest comparability at national level and also in the states.

The migration rate thus obtained was multiplied by a factor determined by the Census Bureau to derive the migration rate for the total population. The factor concerning civilian migration ranges from 1.41 in 1951 to .93 used in the 1956 estimate. The decline in this ratio results from the fact that progressively younger children are included in the school-age group as the period increases, and migration rates are higher for families with younger children than for those with older ones. For example in 1951 the group 7½ to 14½ was 6½ to 13½ in the base year. Conversely, the children 7½ to 14½ in 1956 were 1¼ to 8¼ in 1950. A much larger proportion of these children were pre-school age and, therefore, their families tended to move more than the group closer to the base year. Since this annual migration rate for ages under 6½ was higher than for the ages 6½ to 14½, the ratio of the net migration rate for the total population to that of the age group covering six years is smaller than the corresponding ratio covering the one-year period.

To find the population aged 7½ to 14½ in the estimate year, a ratio was set up between the enumeration of children in this age group in 1950 and the number enrolled in corresponding grades in school. This ratio was then applied to the school enrollment figures for 1956, resulting in the estimated number of children 7½ to 14½ years of age that year. Next, the number of children 1¼ to 8¼ in 1950, or the number expected to survive to 7½ to 14½ in 1956, was obtained from the Census.[4] Two adjustments to these figures were necessary.

First, censuses usually miss a sizeable number of children under 5 years of age. Since the population 7½ to 14½ years old in 1956 was 1¼ to 8¼ in 1950, it was important that the figures for the age range under 5 years be adjusted to account for underenumeration. If this adjustment were not made, the survivors of the 1950 population would be noticeably lower than the supposed number which would be enumerated in a census in 1956. The percentages of completeness of registration for Mississippi, available from the Bureau of the Census, are in the following table.

Table 1. Estimated percentage completeness of enumeration of the population under 5 years old, by age, color, and sex, for Mississippi, April 1, 1950.

Age groups	White		Nonwhite	
	Male	Female	Male	Female
Under 1 year	88.3	89.3	82.0	83.9
1 year	98.1	99.2	88.8	88.6
2 years	92.8	94.7	93.3	95.0
3 years	95.5	97.0	98.2	98.3
4 years	100.0	100.0	91.7	91.3

Thus the age groups involved were divided by the appropriate percentages to include the "uncounted" population.

Second, survival rates determined by the Bureau of the Census were applied to the population 1¼ to 8¼ in 1950, in order to estimate how many of these children could be expected to survive until 1956. Since survival factors for counties were not available, it was necessary to use the figures for the state. However, these rates are obtainable by race.

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[4] Age groups obtained from the Census were figured from April 1, 1950 (date of Census) which accounts for the fraction of one-fourth. Likewise, ages in the estimate year were computed to July 1, 1956 (date of estimate) and contain the fraction one-half.

Table 2. Survival factors for computing the expected number of children elementary school age (7 1/2 to 14 1/2 years old), for estimate date, July 1, 1956, by race and sex.

Sex	White	Nonwhite
Male	.99561	.99239
Female	.99675	.99435

The expected population was compared with the estimated population for 1956, and the net change found between the two figures. This number was divided by the population 1¼ to 8¼ in 1950 to find the migration rates for this age group. The constant of .93, multiplied by this rate, established the civilian migration rate which was then applied to the county population base, resulting in the number of migrants in or out of the county.

The population base mentioned above was found by adding the civilian population in 1950, one half of the births during the period, and the population not enumerated in 1950, and by subtracting the net loss to the Armed Forces during the period. In using one half of the births, it was assumed that they were distributed evenly over the estimate period, and that the newly born persons were alive for only one half of the period and should therefore have experienced net migration at only one half the computed rate. Since it was undesirable to halve the migration rate to apply to the births, the same result was obtained by using one half the number of births and multiplying by the total migration rate.

Net migration in Hinds County for 1956, white population	11,272
1. Estimated white population 7 1/2 - 14 1/2, 1956	13,578
(a) White population 7 1/4 - 14 1/4, April 1, 1950	8,224
(b) Number enrolled, same date	7,747
(c) Ratio (a÷b)	1.0615
(d) Number enrolled July 1, 1956	12,791
(e) Estimated white population 7 1/2 - 14 1/2, same date (d x c)	13,578
2. Migration rate, white population	.1337
(a) Expected white population elementary school age 1956 (from Census)	11,865
(b) Net change in white population group between 1950 and 1956 (1 — 2a)	1,713
(c) Migration rate for white population group (b÷11,911, size of group in 1950)	.1439
(d) Migration rate for total white population (.1439 x .93)	.1337
3. White population base	84,308
(a) White civilian population, 1950	78,089
(b) One-half white births during period	6,742
(c) White net loss to Armed Forces	961
(d) White population under 5 not enumerated, 1950	438
(e) White population base (a + b — c + d)	84,308
4. White net civilian migration (2 x 3)	11,272

One further adjustment became necessary when the white and non-white migration rates for the counties in Mississippi were computed. In the primary step of comparing school enrollment with estimated population, it was felt that some of the nonwhite increase was due more to improved school attendance than to inmigration. Thus, in cases where the nonwhite ratio was significantly larger than the white, an adjustment was made, reducing the former ratio to a more understandable one. To do this, the difference between the two ratios was found. It was assumed that attendance percentages for the two races will equalize by 1960; therefore, the above difference was divided by 10—the period from 1950 to 1960— in order to determine the amount of equalization per year. Then this yearly figure was multiplied by six to include the years covered by the estimate. The resulting figure was subtracted from the nonwhite ratio to account for improved school attendance.

Net migration in Hinds County for 1956, nonwhite population	—1,481
1. Estimated nonwhite population 7 1/2 - 14 1/2, 1956	12,489
(a) Nonwhite population 7 1/4 - 14 1/4, April 1, 1950	10,134
(b) Number enrolled, same date	7,747
(c) Ratio (a : b: (difference between original ratio of 1.0857 and white ratio of 1.0615 was multiplied by .6 and subtracted from original ratio	1.0713)
(d) Number enrolled July 1, 1956	11,658
(e) Estimated nonwhite population 7 1/2 - 14 1/2, same date (d × c)	12,489

The procedures for deriving the migration rate and the nonwhite base were identical to those used for the white population and resulted in a net migration for the nonwhite population of —1481.

Net Loss to Armed Forces, 1950-1956

The figure showing net loss to the Armed Forces does not include all of the people who have served in the Armed Forces, but rather is the average number from Mississippi in the Services at a given time. In 1956, the state's net contribution to the military organizations was 26,000 persons. In order to assign these people to the counties, a ratio was first set up between the number of men 18 to 24 years old in each county and in the state as a whole. Then the total number in service was multiplied by this ratio to determine the county's portion in service. Another step was necessary to break down the net loss into white, nonwhite categories, since there was no available data on racial composition of the Armed Forces. The original group of men 18 to 24 in each county was divided into its white and nonwhite components and the percentages by race obtained. Then these percentages were applied to the number in the Armed Forces from the county in order to derive the racial composition of the net loss to the Armed Forces.

Net loss to Armed Forces, Hinds County April 1, 1950 to July 1, 1956	1,756
(a) Males 18-24 in county, 1950	7,873
(b) Males 18-24 in state, 1950	119,925
(c) Ratio (a ÷ b)	.0656
(d) Net loss to Armed Forces, Mississippi, 1956	26,000
(e) Net loss to Armed Forces, Hinds County, 1956 (d x c)	1,756

Estimated Civilian Population, 1956

The components of the population estimate were combined to obtain the total civilian population in the county. These factors were the base civilian population in 1950, and the natural increase, net civilian migration, and net loss to Armed Forces from 1950 through 1956.

Civilian population, Hinds County, 1956	170,473
(a) Civilian population, April 1, 1950	141,991
(b) Natural increase, 1950-1956	20,447
(c) Net civilian migration, 1950-1956	9,791
(d) Net loss to Armed Forces, 1950-1956	1,756
(e) Civilian population, July 1, 1956 (a + b + c — d)	170,473

Estimated Total Population, 1956

The total population for the county is the sum of the civilian population and the military personnel stationed in the county. The figures concerning placement of military personnel were obtained from the Department of Defense and also from state and local units. Since this information could not be subdivided into white and nonwhite personnel, the total population for the state and for counties was not computed by race.

Estimated total population, Hinds County, 1956	170,668
(a) Estimated civilian population, Hinds County	170,473
(b) Military personnel in county 1956	195
(c) Estimated total population, Hinds County, 1956	170,668

Appendix Table 1. **Adjusted population of counties in Mississippi for the years 1950 through 1956.**

	1950	1951	1952	1953	1954	1955	1956
Mississippi	2,178,914	2,195,900	2,186,600	2,161,200	2,130,500	2,133,300	2,123,700
Adams	32,256	34,400	35,600	35,000	35,400	35,200	36,600
Alcorn	27,158	27,100	26,600	26,500	26,100	26,500	25,300
Amite	19,261	19,500	19,200	17,400	18,300	16,600	17,000
Attala	26,652	26,900	24,000	24,900	24,700	23,300	23,300
Benton	8,793	7,800	7,900	7,900	8,400	8,200	8,500
Bolivar	63,004	63,500	62,200	64,100	60,100	58,400	59,500
Calhoun	18,369	18,400	18,600	16,000	15,800	15,100	15,200
Carroll	15,499	14,900	13,400	13,100	13,200	13,400	13,000
Chickasaw	18,951	18,700	18,500	18,100	16,900	17,200	17,300
Choctaw	11,009	10,400	9,900	9,700	9,400	9,200	9,400
Claiborne	11,944	11,300	11,800	11,400	10,900	11,300	11,300
Clarke	19,362	19,100	19,700	18,700	17,600	18,100	17,400
Clay	17,757	16,500	15,700	14,700	15,000	14,900	15,200
Coahoma	49,361	54,200	54,400	56,700	53,400	55,800	52,900
Copiah	30,493	29,600	29,800	28,800	28,000	27,900	27,600
Covington	16,036	16,200	16,300	15,400	15,100	15,500	15,400
De Soto	24,599	23,800	27,100	23,000	21,500	24,200	24,200
Forrest	45,055	46,700	45,200	43,700	44,700	44,800	44,800
Franklin	10,929	11,100	9,700	9,000	9,000	9,200	8,900
George	10,012	9,300	9,700	10,300	10,400	10,300	10,600
Greene	8,215	8,200	7,500	7,700	7,800	7,800	8,000
Grenada	18,830	18,300	19,400	20,000	18,200	18,500	18,800
Hancock	11,891	11,900	13,100	12,400	12,500	13,500	13,200
Harrison	84,073	93,000	92,900	99,100	102,800	104,800	105,400
Hinds	142,164	149,700	157,200	159,500	158,300	165,100	171,800
Holmes	33,301	30,700	30,500	28,600	29,600	29,900	28,200
Humphreys	23,115	22,200	22,200	22,100	22,700	21,300	21,400
Issaquena	4,966	4,600	4,600	4,500	4,200	4,300	4,900
Itawamba	17,216	17,600	16,600	16,900	15,100	14,000	13,700
Jackson	31,401	30,200	35,300	42,600	39,700	41,000	42,700
Jasper	18,912	19,700	17,600	17,600	16,900	18,500	17,100
Jefferson	11,306	11,500	11,100	10,600	10,600	11,200	10,100
Jeff. Davis	15,497	15,700	14,700	15,600	15,800	16,700	16,200
Jones	57,235	54,100	55,500	51,600	51,800	54,500	51,900
Kemper	15,893	14,900	15,500	13,700	13,300	12,200	12,000
Lafayette	22,798	21,200	19,200	15,400	17,400	17,000	16,300
Lamar	13,225	12,800	13,200	12,200	11,600	10,300	12,400
Lauderdale	64,171	65,000	68,900	64,300	63,100	63,000	62,500
Lawrence	12,639	12,900	13,300	12,500	11,700	11,800	11,600
Leake	21,610	19,700	16,800	15,200	16,500	16,100	15,600
Lee	38,237	37,200	39,200	37,000	37,000	37,300	37,600
Leflore	51,813	49,600	50,000	49,800	49,700	48,400	46,300
Lincoln	27,899	26,100	24,700	24,700	25,200	26,000	26,400
Lowndes	37,852	36,600	38,000	38,700	38,100	38,700	37,600
Madison	33,860	34,500	32,300	34,700	32,900	33,000	32,500
Marion	23,967	24,600	25,100	22,700	21,200	22,800	22,800
Marshall	25,106	24,400	25,400	24,100	23,400	24,000	23,100
Monroe	36,543	36,000	35,200	33,900	32,600	29,000	30,600
Montgomery	14,470	14,700	14,400	15,200	14,800	14,500	13,900
Neshoba	25,730	24,500	25,100	20,900	19,800	19,000	18,300

Appendix Table 1. Adjusted population of counties in Mississippi for the years 1950 through 1956. (Continued)

	1950	1951	1952	1953	1954	1955	1956
Newton	22,681	23,100	20,600	21,400	19,600	18,400	19,100
Noxubee	20,022	19,500	18,400	18,000	19,500	17,200	17,300
Oktibbeha	24,569	27,100	25,800	25,900	25,300	25,200	22,200
Panola	31,271	32,400	31,900	32,500	33,900	32,600	32,300
Pearl River	20,641	22,100	22,100	21,200	21,800	22,200	21,700
Perry	9,108	9,000	8,200	7,800	7,700	7,400	7,200
Pike	35,137	35,400	36,500	36,300	36,000	36,600	32,400
Pontotoc	19,994	19,800	19,900	18,900	18,600	19,200	18,300
Prentiss	19,810	20,300	21,600	21,300	18,900	18,500	18,300
Quitman	25,885	27,500	25,400	27,900	25,300	25,400	25,600
Rankin	28,881	34,300	31,000	30,500	27,500	26,800	27,600
Scott	21,681	20,800	22,100	20,400	20,100	20,500	20,000
Sharkey	12,903	11,500	11,300	11,400	12,100	12,500	12,500
Simpson	21,819	20,800	20,900	20,700	21,200	21,200	21,200
Smith	16,740	16,000	15,200	14,200	13,900	13,500	13,800
Stone	6,264	7,200	6,500	6,400	6,400	6,400	6,400
Sunflower	56,031	57,600	56,400	55,200	56,000	54,800	54,500
Tallahatchie	30,486	32,500	30,100	28,700	28,000	29,200	28,600
Tate	18,011	18,400	17,800	16,800	16,800	17,000	17,400
Tippah	17,522	17,500	16,800	18,000	18,200	17,300	16,700
Tishomingo	15,544	14,200	13,600	13,300	13,400	13,500	13,100
Tunica	21,664	21,900	23,000	22,700	22,900	22,000	22,900
Union	20,262	17,700	18,500	23,000	21,300	19,900	18,900
Walthall	15,563	15,900	14,900	16,000	15,700	14,000	14,400
Warren	39,616	42,700	41,900	40,700	39,600	39,300	39,700
Washington	70,504	75,700	71,600	70,100	72,800	74,500	77,000
Wayne	17,010	17,400	16,500	15,900	15,900	15,800	15,600
Webster	11,607	11,400	11,400	10,700	10,800	10,600	10,600
Wilkerson	14,116	14,000	14,400	14,300	13,900	13,300	13,200
Winston	22,231	21,800	21,500	21,000	20,700	20,200	19,600
Yalobusha	15,191	13,400	14,600	14,100	13,200	13,000	13,100
Yazoo	35,712	35,700	26,400	37,300	35,400	36,100	36,200

NOTE: The estimated populations for the years 1951 through 1956 are rounded to the nearest hundred. The county data have been adjusted so that the state total for each year is equated to the most recent estimate prepared by the Bureau of the Census.

Appendix Table 2. Adjusted population of counties in Mississippi for the years 1950 through 1956, by race.

		1950	1951	1952	1953	1954	1955	1956
Mississippi	W	1,175,604	1,169,200	1,165,300	1,136,100	1,131,700	1,132,000	1,157,200
	NW	989,241	1,001,800	996,300	1,000,500	973,500	975,800	978,800
Adams	W	16,138	17,300	18,900	18,500	18,300	18,300	19,400
	NW	16,102	17,200	16,700	16,600	17,100	16,900	17,100
Alcorn	W	23,251	23,100	22,900	22,900	22,500	22,500	21,600
	NW	3,903	3,900	3,800	3,600	3,600	3,900	3,600
Amite	W	8,820	7,200	8,100	6,600	7,400	7,200	7,200
	NW	10,436	12,300	11,200	10,800	10,900	9,400	9,800
Attala	W	15,077	15,000	13,400	13,500	13,200	12,100	12,400
	NW	11,566	11,800	10,600	11,400	11,600	11,100	11,000

Appendix Table 2. Adjusted population of counties in Mississippi for the years 1950 through 1956, by race (continued)

		1950	1951	1952	1953	1954	1955	1956
Benton	W	4,942	4,100	4,000	4,000	4,200	4,100	4,300
	NW	3,850	3,700	4,000	3,900	4,100	4,000	4,200
Bolivar	W	19,860	19,500	19,700	19,000	18,700	17,800	17,700
	NW	43,127	44,000	42,500	46,200	41,500	40,500	41,800
Calhoun	W	14,078	14,100	14,000	11,400	11,500	10,900	10,600
	NW	4,289	4,300	4,600	4,600	4,400	4,200	4,600
Carroll	W	6,661	5,700	5,400	5,400	5,400	5,000	4,900
	NW	8,835	9,200	8,000	7,700	7,800	8,500	8,200
Chickasaw	W	10,523	10,800	10,400	9,800	9,700	9,900	9,900
	NW	8,423	7,900	8,100	8,300	7,100	7,300	7,300
Choctaw	W	7,679	7,500	6,900	6,700	6,200	6,300	6,200
	NW	3,329	3,000	2,900	3,000	3,100	3,000	3,200
Claiborne	W	3,009	2,400	3,200	3,000	2,900	3,000	3,100
	NW	8,934	8,900	8,700	8,400	8,000	8,200	8,200
Clarke	W	11,473	11,300	11,700	10,900	10,200	10,100	10,200
	NW	7,879	7,700	8,000	7,800	7,400	7,900	7,300
Clay	W	7,660	7,400	7,400	7,400	7,700	7,600	7,700
	NW	10,093	9,000	8,300	7,300	7,200	7,300	7,500
Coahoma	W	13,692	13,000	15,000	16,700	14,800	15,100	14,500
	NW	35,652	41,100	39,400	40,000	38,700	40,700	38,500
Copiah	W	14,205	13,300	12,900	12,200	12,200	12,700	12,500
	NW	16,281	16,300	16,900	16,500	15,800	15,200	15,100
Covington	W	10,820	10,400	10,600	9,800	9,600	9,600	9,600
	NW	5,211	5,800	5,700	5,600	5,400	5,900	5,800
De Soto	W	8,070	9,100	8,400	8,500	8,300	8,200	8,500
	NW	16,521	14,700	18,600	14,500	13,200	16,000	15,800
Forrest	W	32,067	33,500	32,000	30,700	31,800	31,900	32,500
	NW	12,960	13,000	13,300	13,000	13,000	12,800	12,300
Franklin	W	6,623	6,500	6,000	5,200	5,200	5,500	5,300
	NW	4,304	4,500	3,700	3,800	3,700	3,700	3,500
George	W	8,780	8,100	8,600	9,000	9,100	8,900	9,300
	NW	1,231	1,200	1,100	1,400	1,200	1,300	1,300
Greene	W	6,706	6,700	6,100	6,400	6,300	6,300	6,300
	NW	1,504	1,500	1,400	1,400	1,500	1,500	1,600
Grenada	W	8,996	8,700	8,600	8,700	8,400	8,600	8,800
	NW	9,828	9,700	10,800	11,200	9,700	9,900	10,100
Hancock	W	9,846	9,800	12,400	10,400	10,600	11,600	11,900
	NW	2,038	2,100	1,900	2,100	1,900	1,900	1,300
Harrison	W	58,658	57,900	58,100	62,800	65,800	66,900	67,300
	NW	12,559	13,200	12,900	14,600	14,600	15,500	15,700
Hinds	W	78,090	83,400	88,400	86,500	89,700	94,600	98,800
	NW	63,901	66,200	68,700	72,700	68,400	70,300	72,800

Appendix Table 2. Adjusted population of counties in Mississippi for the years 1950 through 1956, by race (continued)

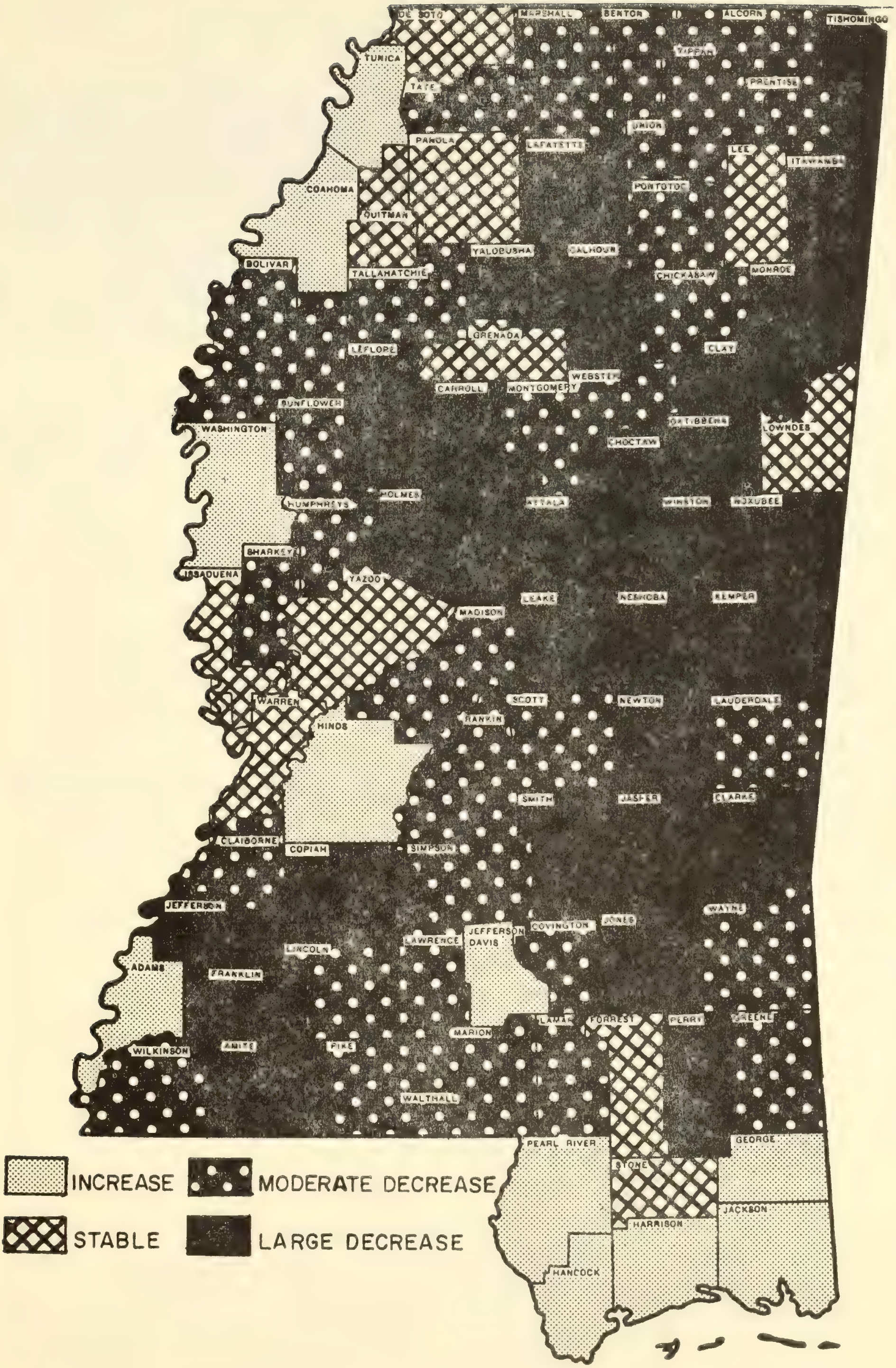
		1950	1951	1952	1953	1954	1955	1956
Holmes	W	8,821	8,200	8,100	7,100	7,400	7,000	6,800
	NW	24,467	22,500	22,500	21,400	22,100	22,800	21,300
Humphreys	W	7,011	6,500	6,500	6,500	6,200	6,200	6,000
	NW	16,101	15,800	15,600	15,700	16,400	15,200	15,400
Issaquena	W	1,617	1,500	1,800	1,700	1,600	1,500	1,900
	NW	3,348	3,100	2,800	2,800	2,600	2,800	2,900
Itawamba	W	16,269	16,600	15,600	15,800	14,200	13,100	12,800
	NW	937	1,000	900	1,000	900	900	900
Jackson	W	24,357	23,200	28,000	34,500	31,600	32,400	34,100
	NW	6,730	7,000	7,300	8,000	8,100	8,500	8,600
Jasper	W	9,192	10,300	8,100	7,800	7,800	9,200	8,100
	NW	9,716	9,500	9,500	9,800	9,000	9,300	9,100
Jefferson	W	2,887	2,700	2,800	2,400	2,500	2,900	2,400
	NW	8,419	8,800	8,300	8,100	8,000	8,300	7,700
Jeff. Davis	W	6,889	6,300	6,300	5,800	6,600	6,500	6,400
	NW	8,608	9,400	8,300	9,800	9,200	10,200	9,900
Jones	W	42,181	38,900	40,500	37,200	37,900	40,700	37,900
	NW	15,027	15,200	15,000	14,400	13,900	13,700	13,900
Kemper	W	6,458	5,400	5,600	4,900	4,600	3,800	3,700
	NW	9,433	9,500	9,900	8,800	8,600	8,400	8,300
Lafayette	W	14,668	14,100	10,900	6,800	9,100	8,600	8,200
	NW	8,089	7,100	8,300	8,500	8,200	8,300	8,200
Lamar	W	11,115	11,000	11,400	10,300	9,600	8,600	10,500
	NW	2,106	1,700	1,900	2,000	1,900	1,600	2,000
Lauderdale	W	40,756	42,800	44,600	40,400	40,000	39,700	39,600
	NW	23,374	22,200	24,200	23,900	23,100	23,300	22,800
Lawrence	W	7,873	7,700	8,500	7,800	7,200	7,000	6,900
	NW	4,758	5,200	4,800	4,600	4,400	4,900	4,700
Leake	W	12,444	11,900	10,100	7,700	8,400	8,500	8,300
	NW	9,164	7,700	6,700	7,400	8,000	7,600	7,300
Lee	W	27,564	26,900	28,300	26,000	26,300	25,900	26,200
	NW	10,658	10,300	10,900	11,000	10,700	11,400	11,500
Leflore	W	16,457	15,800	16,000	15,400	16,300	15,900	15,800
	NW	35,327	33,800	33,900	34,400	33,400	32,600	30,400
Lincoln	W	18,711	17,300	15,300	15,000	15,800	16,500	16,800
	NW	9,184	8,800	9,300	9,800	9,300	9,500	9,600
Lowndes	W	19,421	19,500	20,400	20,300	20,800	20,600	20,700
	NW	18,409	16,900	17,400	18,200	17,200	17,900	16,700
Madison	W	8,920	7,700	7,900	8,300	7,900	7,900	8,200
	NW	24,932	26,800	24,300	25,400	25,000	25,200	24,400
Marion	W	15,567	16,000	16,100	13,900	12,700	13,400	13,400
	NW	8,391	8,600	8,900	8,800	8,500	9,400	9,500

Appendix Table 2. Adjusted population of counties in Mississippi for the years 1950 through 1956, by race (continued)

		1950	1951	1952	1953	1954	1955	1956
Marshall	W	7,372	7,200	6,900	7,000	7,100	7,000	6,500
	NW	17,731	17,300	18,500	17,400	16,300	17,000	16,500
Monroe	W	22,819	22,500	21,400	19,600	19,600	19,400	19,100
	NW	13,710	13,500	13,900	14,400	13,000	9,600	11,500
Montgomery	W	8,245	8,700	7,900	8,300	8,000	7,900	7,400
	NW	6,224	6,100	6,400	6,800	6,700	6,600	6,400
Neshoba	W	19,054	18,200	18,700	15,100	14,100	13,000	12,800
	NW	6,662	6,300	6,300	5,900	5,700	5,900	5,500
Newton	W	14,522	14,400	12,800	13,200	12,500	11,400	11,300
	NW	7,551	8,700	7,900	8,100	7,100	7,000	7,900
Noxubee	W	5,114	5,400	4,700	4,800	4,800	4,700	4,800
	NW	14,903	14,100	13,900	13,200	14,600	12,500	12,500
Oktibbeha	W	12,800	14,800	12,400	12,200	12,200	11,700	11,300
	NW	11,750	12,200	13,400	13,700	13,100	13.400	10,900
Panola	W	13,778	12,800	12,500	13,000	13,200	12,700	13,000
	NW	17,488	19,600	19,500	19,500	20,700	19,800	19,300
Pearl River	W	16,143	16,000	16,400	16,000	16,400	16,500	16,600
	NW	4,493	6,200	5,600	5,200	5,400	5,700	5,100
Perry	W	6,894	6,700	6,100	5,600	5,500	5,500	5,200
	NW	2,211	2,300	2,100	2,200	2,100	1,900	2,000
Pike	W	19,419	19,300	20,300	19,800	19,600	19,100	17,400
	NW	15,705	16,200	16,200	16,500	16,400	17,500	15,000
Pontotoc	W	16,165	16,000	15,100	14,800	15,200	15,500	14,800
	NW	3,815	3,800	4,700	4,100	3,500	3,700	3,500
Prentiss	W	17,468	17,500	18,700	17,600	16,500	16,200	16,000
	NW	2,333	2,900	3,000	3,700	2,400	2.300	2,200
Quitman	W	10,183	10,600	10,600	11,000	10.100	9,800	9,500
	NW	15,698	16,800	14,800	16,900	15,200	15,600	16,200
Rankin	W	15.204	20,800	15,900	16,300	13,700	14,300	15,400
	NW	13,069	13,500	15,000	14,200	13,800	12,500	12,200
Scott	W	12,863	11,400	12,700	11,100	11,100	10,700	11,000
	NW	9,570	9,400	9,400	9,200	9,100	9,800	9,100
Sharkey	W	3,767	2,400	3,200	2,800	3,500	3,600	3,300
	NW	9,193	9,200	8,100	8,500	8,600	8,900	9,200
Simpson	W	14,548	14,000	13,500	13,200	13,300	13,000	13,100
	NW	7,270	6,700	7,400	7,500	7,900	8,100	8,200
Smith	W	13.348	12,900	12,400	12,000	11,200	10.900	11,200
	NW	3,390	3,000	2,900	2,500	2,600	2,600	2,600
Stone	W	4,896	5,300	4,900	4,800	4,900	5,100	4,900
	NW	1,365	1,800	1,600	1,600	1,400	1,300	1,500
Sunflower	W	17,868	17,600	17,200	17,200	17,000	16,900	16,500
	NW	38,157	40,100	39,200	38,000	38,900	37,900	38,000

Appendix Table 1. Adjusted population of counties in Mississippi for the years 1950 through 1956. by race (continued)

		1950	1951	1952	1953	1954	1955	1956
Tallahatchie	W	11,074	11,000	10,300	10,700	10,600	10,000	10,100
	NW	19,407	21,500	19,800	18,000	17,600	19,200	18,600
Tata	W	7,637	7,600	7,400	7,100	7,000	7,000	6,800
	NW	10,367	10,900	10,400	9,700	9,800	10,000	10,500
Tippah	W	14,126	13,000	14,100	13,700	14,100	13,200	13,000
	NW	3,391	4,400	2,800	4,300	4,100	4,000	3,700
Tishomingo	W	'14,737	13,100	12,800	12,500	12,700	12,500	12,400
	NW	806	1,100	900	800	800	1,000	700
Tunica	W	3,938	4,800	5,300	5,200	4,600	4,700	4,400
	NW	17,718	17,000	17,600	17,500	18,300	17,400	18,400
Union	W	16,622	14,500	13,800	18,600	17,300	16,000	14,900
	NW	3,636	3,300	4,700	4,400	4,000	3,900	3,900
Walthall	W	8,391	8,900	7,900	9,000	8,700	7,600	8,000
	NW	7,164	7,000	6,900	6,900	7,000	6,400	6,400
Warren	W	19,476	22,100	22,800	23,000	22,300	22,100	22,800
	NW	20,087	20,500	19,100	17,700	17,200	17,200	16,800
Washington	W	23,402	25,400	24,600	25,700	27,000	29,800	29,500
	NW	47,055	47,800	44,500	42,900	43,300	42,300	45,100
Wayne	W	10,786	11,000	10,400	9,400	9,600	9,600	9,800
	NW	6,215	6,400	6,100	6,600	6,200	6,200	5,800
Webster	W	8,915	8,500	8,400	8,300	8,400	8,400	8,100
	NW	2,692	2,900	3,000	2,400	2,300	2,200	2,500
Wilkinson	W	4,357	4,000	3,900	3,800	3,300	3,200	3,300
	NW	9,757	10,000	10,600	10,600	10,600	10,100	9,900
Winston	W	12,936	12,300	12,400	11,700	11,600	11,400	11,200
	NW	9,291	9,500	9,100	9,300	9,100	8,800	8,500
Yalobusha	W	8,527	7,700	8,000	7,400	7,100	7,000	6,800
	NW	6,660	5,700	6,600	6,600	6,100	6,000	6,200
Yazoo	W	13,628	14,200	14,300	13,800	13,200	13,600	13,900
	NW	22,075	21,400	22,000	23,500	22,200	22,400	22,300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ITAWAMBA
PONTOTOC
COAHOMA
QUITMAN
YALOBUSHA
CALHOUN
BOLIVAR
TALLAHATCHIE
CHICKASAW
MONROE
GRENADA
LEFLORE
CLAY
WEBSTER
CARROLL
MONTGOMERY
SUNFLOWER
WASHINGTON
OKTIBBEHA
LOWNDES
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
MADISON
LEAKE
NESHOBA
KEMPER
WARREN
SCOTT
NEWTON
LAUDERDALE
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
WAYNE
JEFFERSON DAVIS
COVINGTON
JONES
LAWRENCE
LINCOLN
ADAMS
FRANKLIN
MARION
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
WALTHALL
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK
INCREASE
MODERATE DECREASE
STABLE
LARGE DECREASE

Total population change by counties, 1950-56.

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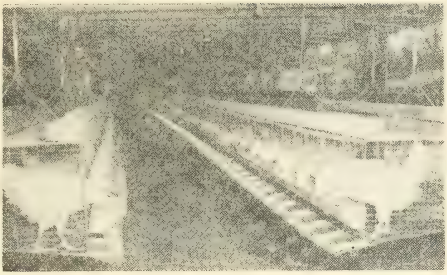
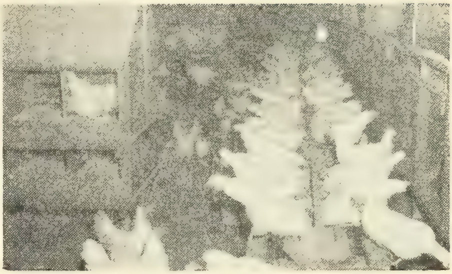
BULLETIN 551 MAY 1957





CAGE

versus

FLOOR OPERATION

For the Production of Commercial Eggs

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

Summary

1. Initial cost for entering each type of operation will vary; however the average initial cost per bird will be about 75 cents more per bird in cages than in the floor unit.

2. In order to keep the cage unit to full capacity, replacements must be started every other month or at regular intervals.

3. The cage unit will result in more uniform egg production throughout the year. This uniformity is highly desirable for the over-all industry.

4. Eight-inch cages will give equal results to ten-inch cages for the Leghorn type bird. This reduction in cage size will result in an increase of 252 more cages in a 1000-capacity house.

5. The over-all mortality was less in cages than on the floor.

6. It took slightly less pounds of feed to produce a dozen eggs in cages than on the floor.

7. Labor income for the first year's operation was in favor of cages.

CAGE VERSUS FLOOR OPERATION FOR THE PRODUCTION OF COMMERCIAL EGGS

By JAMES E. HILL, ROBERT C. ALBRITTON and LESTER J. DREESEN

Commercial egg production has made rapid strides in Mississippi during the past few years. With this growth in production a great number of problems have arisen that could have a definite effect on the continuing growth of the industry and the method of production to be followed in producing these commercial eggs.

Approximately ten years ago the individual laying cage was adapted for the environmental conditions existing in the southern states. At the onset of the growth and popularity of this type of production it became evident that a great number of problems would be involved with the cage operation and with its advantages there would be some decided disadvantages when compared to the conventional floor unit.

House Types

Two houses were constructed at the Northeast Branch Experiment Station to be used in this study. In addition to the work carried on at the Northeast Station, trials involving cage size were conducted at the Poultry Department Farm at State College. The data for the cage size trials are given in Table 2.

The cage house is 24x80 feet in size, 504 capacity, and is constructed from creosote posts. There are three back-to-back rows of 10 x 18 x 18-inch cages extending the full length of the house. The house is covered with aluminum roofing. All other factors in the construction and design of this house are comparable to commercial type cage houses.

The floor unit is constructed from creosote poles and is 24 x 65 feet. This house is also capable of housing approximately 500 laying hens. This unit makes use of planer mill shavings as litter material and is equipped with nests, feeders, roosts and automatic waterers.

It should be noted that one of the undesirable factors in using cages for the production of commercial eggs is the higher initial cost. This cost will vary greatly with each individual producer but the average initial investment will run about 75 cents per bird more in cages than the floor operation. The over-all design and ventilation principles for each unit can be seen in figure 1.

Management Practices

In August of 1955, 504 laying hens were placed in each of the houses. An all-mash system of feeding was used for both units. This mash was formulated from a laying mash concentrate and consisted of 17 percent protein. The same management practices were followed in both houses in that the hens were fed fresh laying mash two times each day. Fresh mash was given to the hens in the morning and late in the afternoon.

In addition to putting out fresh feed twice daily, the feed was stirred each time the operator went into either house. This stirring process was not done an exact number of times each day but on an average of 3 to 4 times daily. It was interesting to note that the hens would go to the feed hopper each time the feed was stirred regardless of the number of stirrings daily. A good example of the increased feed consumption can be seen in figures 2 and 3.

There is definitely a limit to the number of times an operator can stir the feed each day but from the results of these trials, the feed should be stirred every time the operator enters the house as it will pay off in increased feed consumption.

All other management practices were as nearly identical as possible to the recommended commercial operations for these types of units. Eggs were gathered a minimum of three times daily and tak-

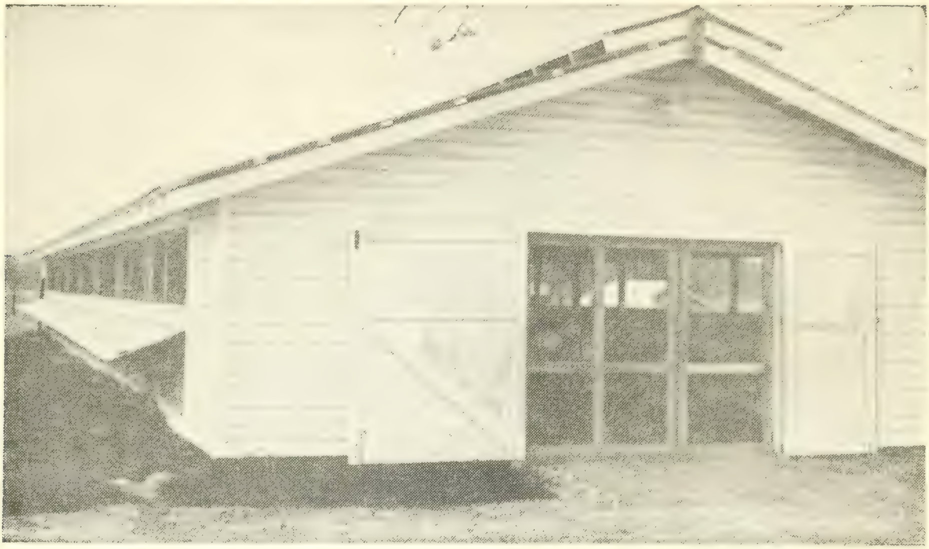


Figure 1. A creosote post type cage house with plenty of ventilation.

en directly to the cooler. No effort was made to determine the comparison of quality of the eggs produced in these two units during the test. A test is now underway at the Poultry Department to determine quality as affected by various types of production.

Lights

In both types of operations, lights were used to increase feed consumption and egg production.

In the cage unit lights were placed 10 feet on center in a diamond shape and mounted over the middle of the cage. This gives a staggered effect with even distribution of light at all points in the house. Twenty-five-watt bulbs were used in this house. The design for the cage house lights can be seen in figure 2.

In the floor unit lights were installed over the feeders and roosts. One 40-watt bulb was allocated for each 200 square feet of floor space. Thirteen to fourteen hours of light were given to each group of hens. Lights were started in early October and discontinued about the middle of April.

Replacements

Possibly the greatest disadvantage and one of the hardest problems involved in the cage operation is that of replacements. It is impossible to keep the cage operation to full capacity without keeping two to three ages of birds on the farm. These varying ages of birds on the same farm results in a somewhat higher mortality rate.

The replacement program followed in these trials was to start 200 sexed pullets every third month with a slightly larger number, depending on the over-all mortality, in January or February. This program may result in a few extra pullets during some periods of the year; however if the cage units are to be kept at full capacity some extra pullets should be on hand at all times. These extra pullets will in most cases produce profitably before being placed in the cage unit and if they are not in heavy production it is doubtful if they will go into a molt at the time they are placed in the cages.

After the pullets had been in the cages for a period of 30 days, they were subject to culling. Culling was done on the basis of birds failing to lay 15 eggs over a 30-day period. Every hen removed from the test on this culling basis was checked very closely because it was found that some birds were good potential producers even though they failed to lay at a 50 percent rate.

In the floor unit the pullets were housed in August and no replacements were made until March. At this time 75 pullets were added to the unit in order to keep the house at full capacity. It should be emphasized that adding pullets to floor type units is not at this time a recommended practice and should not be done under normal practices.

Birds in the floor unit were culled at various intervals and when found to be producing at a nonprofitable rate. At the present time this floor unit is being replaced 100 percent each August as compared to replacing the nonprofitable birds in the cage unit.

Uniformity of Production

Uniform production is highly desirable from the consumers' standpoint and as can be seen from Table 1 the cage opera-

Table 1. **Uniformity of production.**

	Cage unit		Floor unit	
Month	Eggs	Feed	Eggs	Feed
August	4,948	3,400	4,701	2,900
September	10,285	3,300	10,528	3,500
October	11,021	3,700	11,088	4,300
November	11,452	4,300	12,095	3,600
December	11,276	4,450	11,197	3,750
January	11,349	4,600	10,968	4,400
February	10,175	4,100	10,075	3,500
March	10,780	3,600	9,655	3,700
April	10,675	4,000	8,919	3,700
May	10,560	3,500	7,776	3,200
June	10,269	3,500	6,318	3,200
July	4,807	1,700	3,091	1,100
TOTAL	117,597	44,150	106,411	40,850

Table 2. Cage size. Summary of performance from January 1, 1956, to December 31, 1956.

Group number	Cage size	Total no. eggs produced	Percent egg production (hen housed)	Number birds died	Number birds culled
1	8 inch	5,856	53	2	28
2	10 inch	4,764	54	2	23
3.	8 inch	5,869	54	4	29
4	10 inch	4,569	52	3	24
5	8 inch	5,238	48	4	34
6	10 inch	4,061	46	2	30
7	8 inch	5,600	51	9	30
8	10 inch	4,624	53	7	22
9	8 inch	5,779	53	2	32
10	10 inch	4,563	52	4	27
11	8 inch	5,668	52	9	28
12	10 inch	4,679	53	6	21
Average for all trials					
	8 inch	5,668	52	16.6[1]	100[2]
	10 inch	4,543	52	16.6[1]	100[2]
Average for three-year period:					
	8 inch	5,467	52	18.2[1]	92[2]
	10 inch	4,387	52	16.2[1]	93[2]

[1] Percent mortality.

[2] Percent birds replaced.

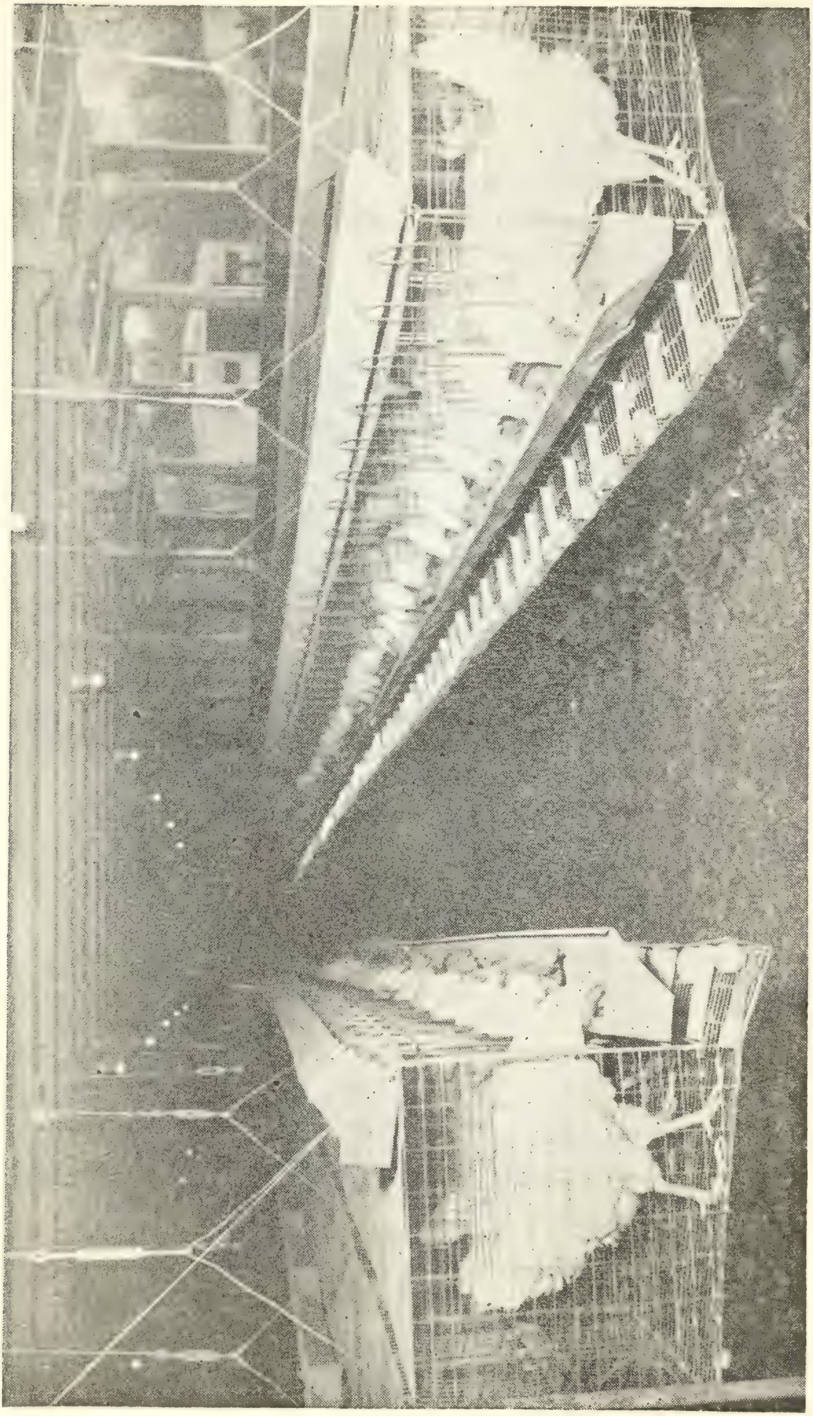


Figure 2. Lights must be properly spaced in a cage unit for best efficiency.

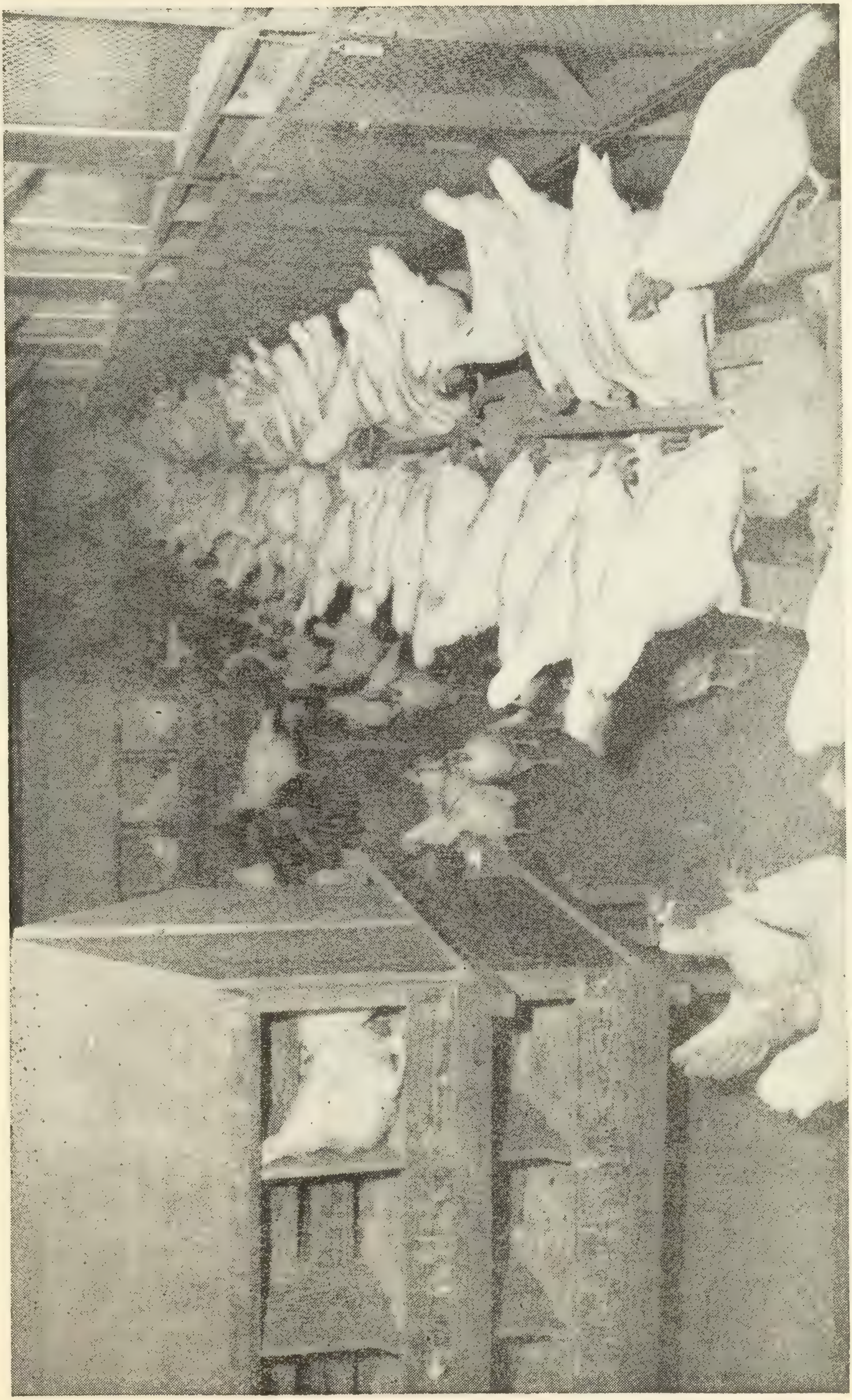


Figure 3. Stirring feed helps to increase feed consumption. Note well ventilated nests.

tion is very desirable from this point of view. From the standpoint of prices received, the drop in yearly production in the floor unit is during the months of March through June when prices will be the lowest; therefore this lack of uniformity may not necessarily show up in overall income.

It is also interesting to note that there is a direct correlation between egg production and feed consumption. In checking Table 1, for example, it took 3,200 pounds of feed to produce 7,776 eggs during the month of May and 3,500 pounds of feed to produce 10,075 eggs during the month of February.

These trials again demonstrated that the most efficient producers were those birds laying at the highest rate.

Cage Size

A producer can purchase cages of most any size that he desires; however, it is easily seen that the smaller the cage the more birds per house, thereby resulting in reduced housing cost. All of the cages in the comparison trials at the Northeast Station were 10 x 18 x 18 inches in size.

To supplement these data an additional project was initiated at the Poultry Farm in 1953 to determine the effect of cage size on egg production. Although the eight inch cage gave comparable results to the ten-inch cage, it is not recommended for heavy type birds.

Averages for the three years can be seen in Table 2. This table also gives the complete results for the last year's operation.

Labor Income

Labor income for a one-year period is given in Table 3. It should be noted that the labor income covers a one year period and the initial cost would offset the advantages for the first year's operation.

Table 3. Comparison of production cost.

	Cage unit	Floor unit
Total replacements	422	504
Number birds died	23	42
Pounds of feed per dozen eggs	4.50	4.60
Cost of replacement[1]	$ 582.36	$ 695.52
Feed cost[2]	1832.22	1695.27
Net income above feed and replacement cost	2093.06	1688.03

[1] Calculated on basis of $1.38 per bird.

[2] Average feed cost $4.15 per 100 birds.

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The Economics of Cotton Defoliation

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

In cooperation with
The Farm Economics Research Division
and the Crops Research Division, Agricultural
Research Service, U. S. Dept. of Agriculture

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THE ECONOMICS OF COTTON DEFOLIATION

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Introduction

The practice of removing leaves from the cotton plant through the use of chemical defoliants received its greatest impetus from the introduction and successful use of spindle type mechanical cotton-pickers during World War II. Since that time, use of this practice has increased until approximately 3,000,000 acres across the cotton belt are treated annually with defoliants of some kind. This represents an outlay of roughly 6 to 10 million dollars a year on the part of producers.

Early experimental work with defoliation indicated that use of the practice resulted in considerable grade improvement where cotton was harvested mechanically. It was further found that, under certain conditions, defoliation caused bolls to open faster, thereby increasing the percentage of the crop harvested in the first picking. Lint and seed in defoliated fields are more exposed to direct sunlight and action of winds. When moisture was present the increased rate of drying was found to reduce deterioration of fiber and seed, to reduce losses from boll rots, and to dry morning dews faster, permitting picking to begin earlier each morning than in undefoliated fields.

In recent years, experimental measurements have indicated that certain of these benefits may no longer be so sharply defined. This is further substantiated by the fact that in some years and under certain conditions farmers have harvested cotton mechanically without defoliation and with no apparent losses in yield or grade. Certainly the use of improved cultural practices, better operation of mechanical pickers, and introduction of improved gin machinery and gin operation have played a part in these changing relationships.

This situation immediately raises the question of the unqualified use of defoliation as an aid to mechanical harvesting and as to the applicability of certain of the existing information relative to benefits to be derived from defoliation.

It was apparent at the outset that certain attributes such as the effect on insect populations, ease of operating machines in defoliated fields, and differences in wear and in machine life could not be measured readily. Further, items such as returns from defoliation because of reduced boll rot, seed and fiber damage and the effects of second growth could only be measured in the event that such conditions occurred within the duration of the test period.

No attempt was made to gain information relative to the role played by defoliation in fields picked by hand.

Methodology and Procedure

Tests concerned with comparisons between mechanically harvested defoliated and undefoliated fields were conducted from 1953 through 1955. It was recognized that individual plots should be of sufficient size to approximate actual farm operations. Further, large plots were required in order to obtain reliable data on machine picker operation and on cotton grades. Five-acre blocks were selected as the size for each of the unreplicated treatments as this was considered to be the largest size that could be satisfactorily controlled within the limitations of the study.

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In order to provide adequate sources of data for comparative purposes and to include as many different growing conditions as possible, eight locations were selected which, in the main, encompassed the Yazoo-Mississippi Delta area. Selections were based on gin facilities, uniformity of stand, of soil type, and of rates of nitrogen fertilization and location within the Delta.

In addition to the defoliated and undefoliated blocks, treatments, using pentachlorophenal as a desiccant were included at selected locations in 1953 and 1954. These treatments included 3 locations in 1953 and 2 locations in 1954.

The data collected included plant activity, size, foliage density, natural defoliation, percentage open cotton at time of defoliation, defoliant costs and cost of application, percentage defoliation at time of first picking, time required for picking, picker efficiency, yield, grade, gin equipment, trash content of seed cotton, trash content of lint, micronaire, and length, strength, and maturity of fiber.

Defoliants were applied when the cotton was approximately 60 percent open, and all applications were made by airplane at the recommended rates.

Weather

Temperature and rainfall data for the 3-year period were obtained from the U.S. Department of Commerce Weather Bureau Station closest to each location. At locations 2, 5 and 7, this was either on the plantation proper or within 5 miles of the plot locations. Weather data at the rest of the locations were taken from stations within a 15-mile radius of the site of the study. It is recognized that local weather conditions at experimental locations varied somewhat from available weather data and that therefore, only rather broad generalizations on the effect of rainfall and temperature are warranted.

Average monthly temperature and rainfall for the 3-year period are compared with the normal average for all locations in Figure 1. Average temperatures for all locations were higher than normal in 1953 and 1954 and close to normal in 1955. The precipitation pattern varied in each year of the test, with the lowest annual rainfall occurring in 1954 and the highest in 1953. Distribution of rainfall was most uniform in 1955 with sufficient precipitation to support adequate growth through July. In each of the 3 years weather was conducive to rapid early season growth, followed by drought conditions during the flowering and fruiting periods. The picking seasons tended to be drier than usual thus reducing the adverse effect of moisture on quality.

The variation from the average rainfall at each location is shown in terms of percentage of normal rainfall encountered annually (table 1) during the flowering and fruiting periods (table 2) and during the picking seasons (table 3). Only in 1954 was annual rainfall substantially below normal regardless of location (table 1). This was due largely to lack of precipitation in February, March and April. It did not affect seasonal growth directly.

Normal rainfall during June, July, and August is not considered sufficient for maximum production of cotton in the Delta area. The comparisons to normal rainfall shown in table 2, are indicative of the drought conditions that existed during this period. During the flowering and fruiting period rainfall at all locations averaged 63 percent of normal in 1953, varying from 45 to 84 percent at individual locations, 38 percent of normal in 1954, ranging from 35 to 46 percent at individual locations, and 91 percent of normal in 1955, ranging from 66 to 145 percent at individual locations.

Precipitation was least during the picking season of 1953 (table 3). It averaged only 44 percent of normal and ranged from 23 to 65 percent at individual locations. In 1954 and 1955, rainfall averaged substantially below normal, 77 to 70 percent respectively. At individual locations

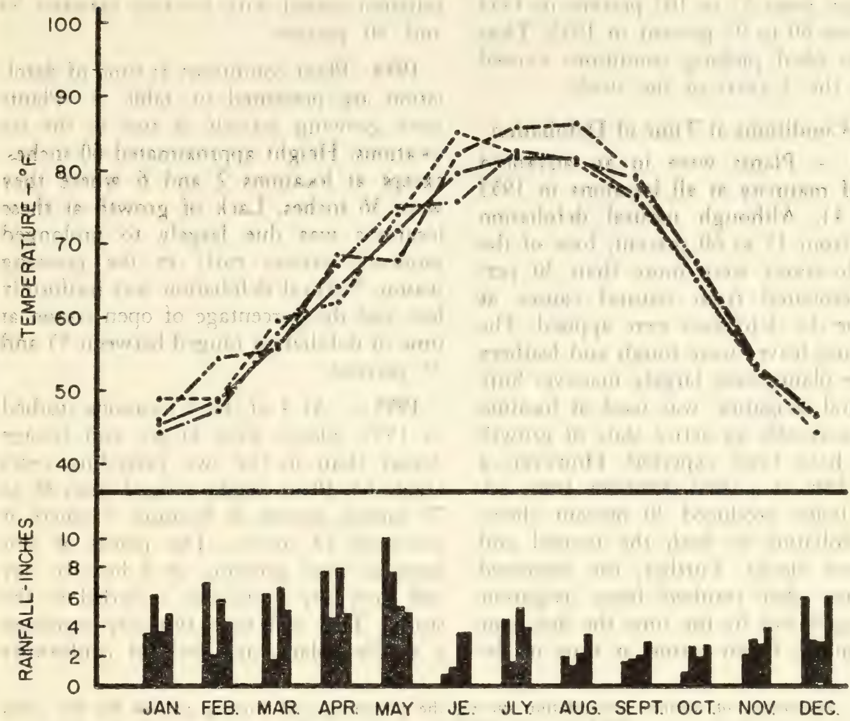


Figure 1.– Comparison of the average monthly rainfall and temperature at all locations with the recorded normal. The four lines representing temperature show little difference. Beginning at the left the top curve is 1953, the second 1954, the third the recorded normal, and the lower curve 1955. The first column in each month at the bottom represents rainfall for 1953, the second 1954, the third 1955, and the last column the recorded normal.

Table 1. Percentage of normal precipitation received during the period 1953 through 1955 for all locations.[1]

Location number	Percentage of normal annual precipitation		
	1953	1954	1955
1.	117	68	-----
2.	106	70	103
3.	96[2]	76[2]	90
4.	90	70	105
5.	109	75[2]	104
6.	110	61	----
7.	94	-----	82
Average	103	70	97

[1] Data taken from nearest U. S. Dept. Commerce recording weather station.

[2] Supplemental irrigation used as required.

it ranged from 52 to 102 percent in 1954 and from 60 to 92 percent in 1955. Thus close to ideal picking conditions existed during the 3 years of the study.

Plant Conditions at Time of Defoliation

1953 — Plants were in an advanced stage of maturity at all locations in 1953 (table 4). Although natural defoliation varied from 15 to 60 percent, four of the seven locations were more than 30 percent defoliated from natural causes at the time the defoliants were applied. The remaining leaves were tough and leathery and the plants were largely inactive. Supplemental irrigation was used at location 3 and normally an active state of growth would have been expected. However, a slight drift of a dust defoliant from adjacent fields produced 20 percent chemical defoliation in both the treated and untreated blocks. Further, the increased succulence that resulted from irrigation was largely lost by the time the defoliant was applied. Open cotton at time of defoliation varied with location between 50 and 80 percent.

1954—Plant conditions at time of defoliation are presented in table 5. Plants were growing actively at two of the six locations. Height approximated 60 inches, except at locations 2 and 6 where they were 36 inches. Lack of growth at these locations was due largely to prolonged moisture stresses early in the growing season. Natural defoliation was uniformly low and the percentage of open cotton at time of defoliation ranged between 55 and 75 percent.

1955 — At 4 of the 5 locations studied in 1955, plants were larger and foliage denser than in the two preceding years (table 6). Plant height ranged from 66 to 72 inches, except at location 3 where it averaged 42 inches. The plants at this location were growing in a heavier clay soil than any previously included in the study. This soil type typically produces a smaller plant, and lack of conformity

Table 2. Percentage of normal precipitation during the flowering and fruiting periods for the years 1953 through 1955 for all locations[1].

Location number	Percentage of normal during June through September		
	1953	1954	1955
1	84	46	..
2.	69	27	97
3.	75	42	66
4.	45	39	145
5	70	35	84
6.	48	38	...
7.	51	...	63
Average	63	38	91

[1]Data taken from closest U. S. Dept. Commerce recording weather station.

Table 3 Percentage of normal precipitation during picking seasons, for the years of 1953 through 1955 at each location[1].

Location number	Percentage of normal precipitation during months of Oct. and Nov.		
	1953	1954	1955
1.	65	64	..
2.	41	77	60
3.	31	102	92
4.	23	99	57
5.	51	69	71
6.	63	52	....
7.	35	.	68
Average	44	77	70

[1]Precipitation data taken from closest recording weather station.

Table 4. Plant condition at time of defoliation, 1953.

Location number	Plants growing actively	Average height	Plants lapping in middles	Foliage density	Natural defoliation	Open cotton
		inches			percent	percent
1.	No	54	Yes	heavy	20	60
2.	No	30	No	light	50	80
3.	No	72	Yes	heavy	30	----
4.	No	40	Yes	medium	40[1]	50
5.	No	54	Yes	heavy	15	60
6.	No	36	Yes	light	60	75
7.	No	54	Yes	medium	35	50
Average		49			36	62

[1] 20 percent chemical from dust defoliant drift from adjacent fields.

Table 5. Plant condition at the time of defoliation, 1954.

Location number	Plants growing actively	Average height	Plants lapping in middles	Foliage density	Natural defoliation	Open cotton
		inches			percent	percent
1.	Yes	56	Yes	heavy	30	60
2.	No	36	Yes	medium	30	75
3.	No	56	Yes	medium	45	70
4.	No	60	Yes	heavy	20	60
5.	Yes	66	Yes	heavy	20	55
6.	No	36	No	medium	50	60
Average		52			32	63

to other locations is attributed to this characteristic. Natural defoliation and percentage of open cotton at time of defoliant application did not vary appreciably from previous years. However, the more uniform distribution of rainfall occurring in 1955 coupled with high boll weevil populations produced plants that did not respond readily to defoliants. As a result, a second application was required at 3 of the 5 locations.

Plant size increased in each successive year. In 1953 it averaged 49 inches, in 1954 52 inches, and in 1955 65 inches. Natural defoliation averaged 36 percent in 1953, 32 percent in 1954, and 34 percent in 1955. The percentage of open cotton at the time defoliants were applied varied only a little from year to year. It averaged 62 percent in 1953, 63 percent in 1954, and 58 percent in 1955.

Plant Condition at Time of First Picking

The first picking was made as quickly as possible following acceptable leaf drop. When a second picking was required, it was completed within the schedule of the producers normal operations. Usually it occurred after his entire acreage of cotton had been picked over once.

1953 — Generally good defoliation of treated blocks was obtained in 1953 (table 7). However, only 50 percent of the leaves were removed at location 7. This was attributed to improper application of the dust defoliant used. A second application was not undertaken because of rapidly increasing differences in uniformity within the experimental blocks.

Although defoliation in the rest of the treated blocks was high, 80 to 95 percent, differences in natural defoliation within untreated blocks varied widely, from 30 to 65 percent. As a result, the differences between treated and untreated blocks, measured as net chemical defoliation, varied from 5 to 55 percent. The highest net chemical defoliation — 55 percent — occurred at locations 3 and 5 and the lowest at location 7.

1954 — A generally low percentage of

natural defoliation was coupled with an excellent response to defoliants in 1954 (table 8). Defoliation in treated blocks ranged from 80 to 99 percent and net chemical defoliation from 45 to 64 percent. The greatest net chemical defoliation during the 3-year test period occurred at location 4. Because the plants were large, foliage density was heavy; and rain occurred between the time the defoliants were applied and first picking, this location was the most likely to yield a high return from defoliation of any measured during the test period.

1955 — Defoliation of treated blocks ranged from 80 to 90 percent in 1955 (table 9). However, second applications were required at 3 of the 5 locations and this delayed first picking. Natural defoliation was high and, as a result, net chemical defoliation was the lowest encountered during the 3-year period. The greatest difference between treated and untreated blocks amounted to only 35 percent and occurred at locations 2 and 4. Only a 5 percent difference in leaf drop separated the treated and untreated blocks at location 7.

Defoliation of treated blocks at all locations averaged 83 percent in 1953, 91 percent in 1954, and 87 percent in 1955. Differences in leaves removed from treated and untreated blocks at all locations averaged 34 percent in 1953, 51 percent in 1954, and 23 percent in 1955. Neither grass and vines, boll rots, nor second growth were present in sufficient quantity during the 3-year period to affect results materially.

Table 6. Plant condition at the time of defoliation, 1955.

Location number	Plants growing actively	Average height	Plants lapping in middles	Foliage density	Natural defoliation	Open cotton
		inches			percent	percent
2.	Yes	72	Yes	heavy	20	55
3.	No	42	Yes	medium	35	60
4	Yes	66	Yes	heavy	30	50
5.	No	72	Yes	heavy	35	50
7.	No	72	Yes	heavy	50	75
Average		65			34	58

Table 7. Plant condition at time of first picking, 1953.

Location number	Treatment	Grass and vines	Second growth	Percentage of defoliation	Net chemical defoliation
1.	defoliant	none	none	85	45
	desiccant	none	none	75	35
	check	none	light	40*	
2.	defoliant	light	trace	90	30
	check	light	trace	60	
3.	defoliant	none	none	95	55
	check	none	none	40	
4.	defoliant	none	none	80	15
	check	none	none	65*	
5.	defoliant	medium	none	85	55
	desiccant	light	light	20	0
	check	medium	none	30	
6.	defoliant	light	none	95	35
	check	light	none	60	
7.	defoliant	none	none	50	5
	desiccant	none	trace	40	0
	check	none	trace	45*	
Average	defoliant			83	34
	check			49	

*Slight drift of defoliant from adjacent plots.

Table 8. Plant condition at time of first picking, 1954

Location number	Treatment	Grass and vines	Second growth	Extent of defoliation	Net chemical defoliation	Rainfall between defoliation and harvest
				percent	percent	inches
1.	defoliant	trace	light	90	50	0.37
	check	trace	light	40		
	desiccant	none	trace[1]	none		
2.	defoliant	light	light	90	60	0.66
	check	light	light	30		
3.	defoliant	trace	light[2]	95	40	1.04
	check	trace	light[2]	55		
4.	defoliant	trace	none	99	64	2.23
	check	trace	light	35		
5.	defoliant	medium	light	80	50	0.03
	check	medium	light	30		
	desiccant	medium	trace	30	none	
6.	defoliant	none	trace	95	45	0.10
	check	none	trace	50		
Average	defoliant			91		
	check			40	51	

[1] In lower portions of plant only.
[2] All buds beginning to grow.

Table 9. Plant condition at time of first picking, 1955.

Location number	Treatment	Grass and vines	Second growth	Extent of defoliation	Net chemical defoliation	Rainfall between defoliation and harvest
2.	defoliant	light	light	90[1]	35	4.66
	check	light	light	55		
3.	defoliant	light	none	85	25	0.42
	check	light	none	60		
4.	defoliant	none	light	90[1]	35	1.30
	check	none	light	55		
5.	defoliant	light	none	80[2]	15	
	check	light	light	65		2.01
7.	defoliant	medium	none	90	5	0.81
	check	medium	none	85		
Average	defoliant			87	23	
	check			64		

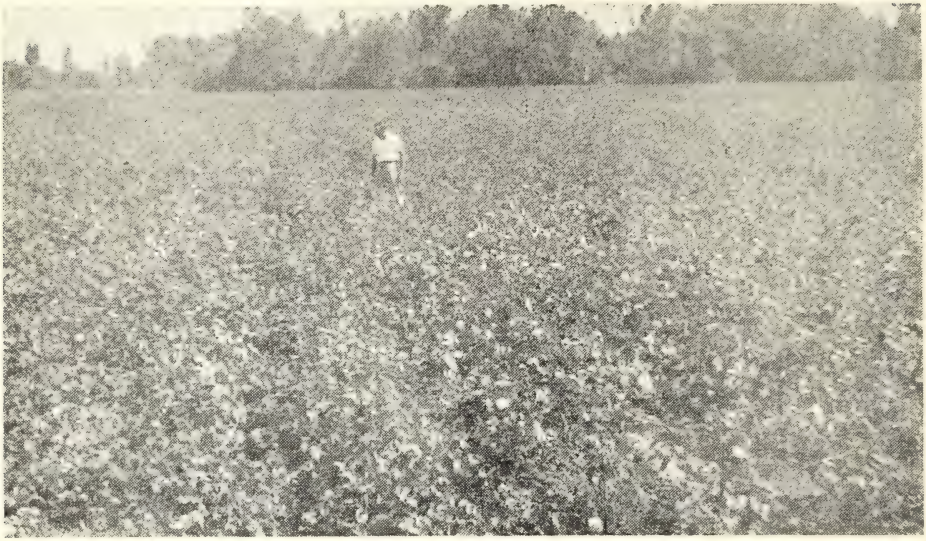
[1] Second application required.
[2] Second application to restricted area.

Direct Costs of Defoliation

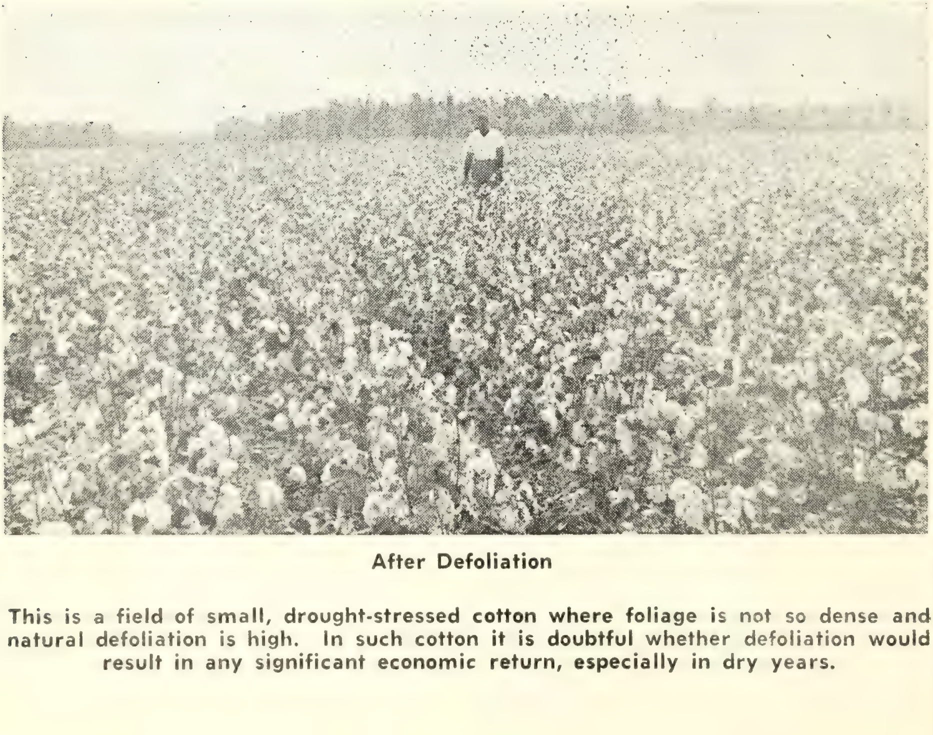
The direct costs of defoliation, which includes materials and application, for the period studied are presented in table 10. Considerable variation in per acre cost occurred, both among years and locations. The relatively low cost of defoliation in 1953 was due to the widespread use of dust defoliants. Dust defoliants are considerably cheaper than liquid but their use is limited by the fact that optimum conditions for their application occur less frequently. Adequate moisture is required where dusts are used and the absence of moisture frequently interferes with timeliness and limits the effectiveness of these materials.

In 1954, liquid defoliants were used exclusively and the slight variations noted in costs were due largely to variations in charges for application.

The relatively high cost of defoliation in 1955 was caused by the necessity for reapplication at certain locations. Conditions requiring these reapplications were explained earlier. Liquid defoliants were used at 7 of the 8 locations in 1955.

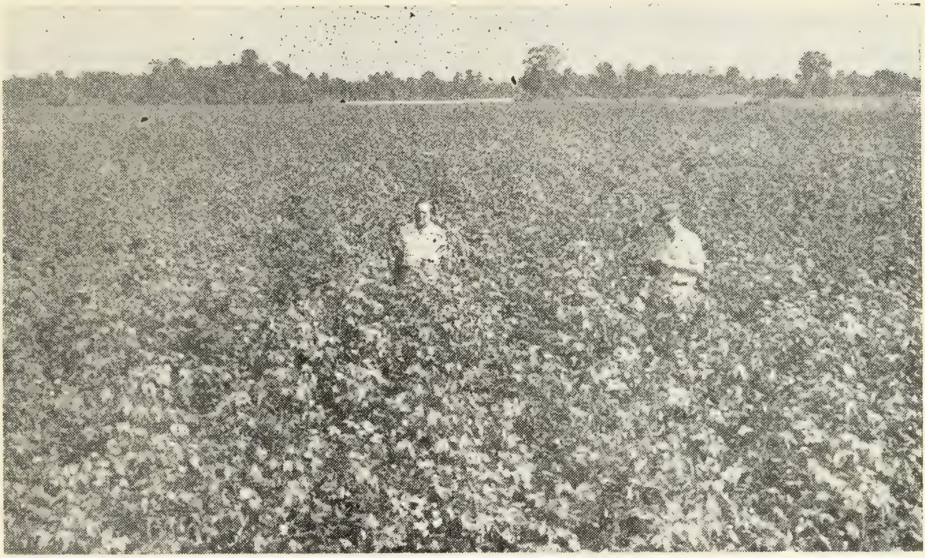


Before Defoliation

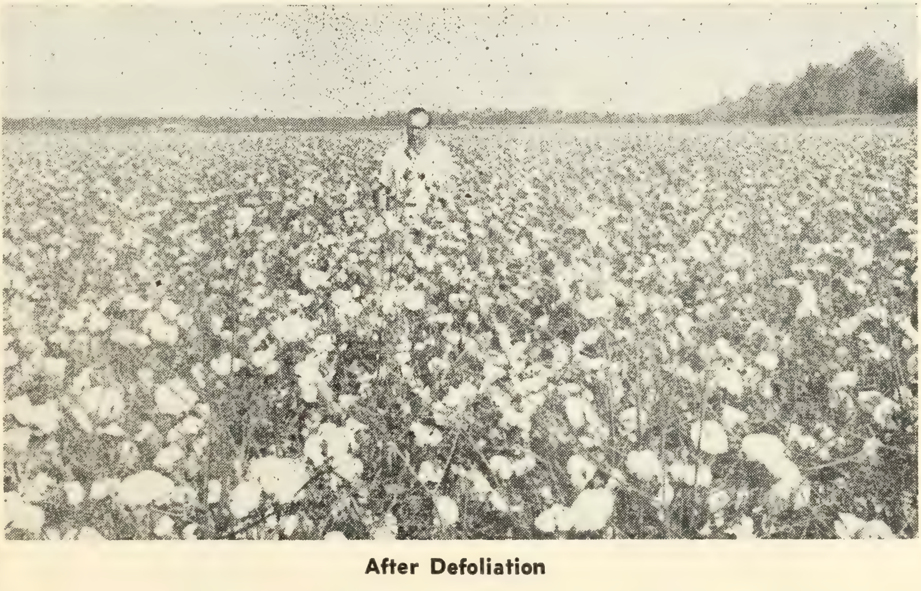


After Defoliation

This is a field of small, drought-stressed cotton where foliage is not so dense and natural defoliation is high. In such cotton it is doubtful whether defoliation would result in any significant economic return, especially in dry years.



Before Defoliation



After Defoliation

This is a field of rank, densely foliaged, heavily fruited cotton grown in the presence of adequate moisture—chances of gaining an economic return from the use of defoliation are very good in cotton such as this.

Under usual conditions, when only one application is required, the per acre cost of using a dust defoliant can be expected to be about $2.25, including $0.90 for application and $1.35 for materials. This figure is based on a 30 pound rate. Higher or lower application rates would alter these costs slightly. A liquid defoliant, under the same conditions, would cost about $4.00 per acre, $2.50 for materials, and $1.50 for application charges.

All costs of application considered here are based on the use of airplanes. The use of ground machines, which could materially alter the cost of defoliation is now being studied and will be covered in a later report.

Yields

At the outset of these trials, intentions were to use the product from an entire plot as a measure of yield. Unfortunately, it was realized early in the tests and it became evident as the season progressed, that yield data, on this basis, would have little, if any significance. Noticeable differences in uniformity were observed at some locations and it could readily be seen that potential yields at these locations would vary between plots. The fact that these differences were noticeable was enough to cast doubt on the validity of the yield information collected in 1953.

Because of the difficulty of getting sufficient uniformity by selection, in plots of this size, and because of the impracticability of replicating plots of this size, subplots were selected in each treatment for yield determinations in 1954 and 1955. These yield plots, approximately one-half acre in size, were located in each treatment so that they were immediately ad-

Table 10. Defoliation costs per acre, 1953-55 and 3-year average.

Location number	Materials and application cost, total			3-year average
	1953	1954	1955	
	dollars	dollars	dollars	dollars
1.	3.16	3.50	3.85	3.50
2.	1.60	3.90	8.00	4.50
3.	3.45	4.25	4.25	4.00
4.	1.87	4.25	8.00	4.70
5.	3.60	4.25	4.50	4.10
6.	3.32	3.90	8.00	5.10
7.	1.87	----	4.00	2.95[1]
8.	----	----	2.00	2.00[2]
Average	2.70	4.00	5.30	3.85

[1] 2-year average.

[2] One year only.

Table 11. Yield in pounds of lint cotton per acre and annual and average yield variation of defoliated from undefoliated cotton.

Location number	2-year average lint yield		Annual and average yield variation of defoliated from undefoliated check		
	Undefoliated	Defoliated	1954	1955	2-year Av.
	pounds	pounds	pounds	pounds	pounds
1.	1028	953[1]	—75	----	—75
2.	760	748	—15	—9	—12
3.	854	826	—51	—5	—28
4.	644	631	—17	—9	—13
5.	829	832	—12	+17	+3
6.	525	520[1]	—5	----	—5
7.	718	704[1]	----	—14	—14
Average			—29	—4	—21

[1] One year only.

jacent to the yield plot in the adjoining treatment.

Yield results from the tests, expressed in pounds of lint per acre, are shown in table 11. Shown are both average lint yields for the 2-year period and annual and average variations in yield of defoliated from undefoliated treatments. Yields are expressed in pounds of lint because of the variation in trash content of seed cotton and because lint represents the actually salable product from each treatment, regardless of the trash present.

At 10 of the 11 locations studied over the 2-year period, a reduction in yield was associated with the use of defoliants. Usually these reductions amounted to less than 20 pounds. In only two instances did they exceed 50 pounds. Over the 2-year period, the average reduction in yield associated with defoliation amounted to 21 pounds per acre, or about 3 percent.

Quality

Cotton gins and gin machinery have been improved considerably in recent years, and especially is this true in terms of their performance on roughly harvested cotton. In any consideration of cotton quality, it is necessary to take into account the influence of the cotton gin. The gin available was one of the most important criteria used in selecting locations for these tests. After first learning whether the gin plant was well enough equipped to handle the harvesting problem, an attempt was made to eliminate the gin variable by getting gins as nearly alike as possible. Because of the many combinations of ginning equipment available, exact duplication could not be attained. The gins included in the study were all equipped with lint cleaners, had one or more tower driers, and all except one were equipped with burr machines. The cleaning equipment for seed cotton ranged from 14 to 21 cylinders. In a further effort to eliminate the gin variable, only the differences in quality from individual gins were considered for analysis.

Foreign matter content is another important consideration in cotton quality and one on which defoliation might possibly have some influence. In an effort to study this problem, samples of seed cotton from each treatment were selected from the wagon or trailer as the cotton

Table 12. A comparison of foreign matter content of wagon and feeder samples, defoliated and undefoliated cotton, 1954, 1955, and 2-year average.

Location number	Treatment	Foreign matter in seed cotton					
		1954		1955		2-year average	
		Wagon	Feeder	Wagon	Feeder	Wagon	Feeder
		percent	percent	percent	percent	percent	percent
1.	Check	7.1	2.4	----	----	7.1	2.4[1]
	Defoliant	6.1	1.7	----	----	6.1	1.7[1]
2.	Check	7.2	1.7	10.2	2.2	8.7	2.0
	Defoliant	5.8	1.4	6.7	1.8	6.2	1.6
3.	Check	6.2	2.5	5.7	2.7	6.0	2.6
	Defoliant	5.3	1.5	4.3	2.6	4.5	2.0
4.	Check	8.6	2.0	5.9	2.3	7.2	2.1
	Defoliant	6.4	1.2	5.3	1.5	5.8	1.4
5.	Check	6.2	1.9	6.8	1.8	6.5	1.8
	Defoliant	5.3	1.7	6.7	1.6	6.0	1.6
6.	Check	7.0	3.0	----	----	7.0	3.0[1]
	Defoliant	5.9	1.9	----	----	5.9	1.9[1]
7.	Check	----	----	9.0	2.8	8.0	2.9[1]
	Defoliant	----	----	7.9	2.0	6.9	2.0[1]
Average	Check	7.0	2.2	7.5	2.4	7.2	2.4
	Defoliant	5.8	1.6	6.2	1.9	5.9	1.7

[1] One year only.

was brought to the gin. A companion set of seed cotton samples was taken from the feeders, after the cotton had been through all seed cotton cleaning equipment in the gin. A similar set of samples of lint cotton was taken from the press box after ginning. These samples were submitted to the laboratory for an analysis of foreign matter content.

Shown in table 12 are the results of the analysis of the seed cotton samples. These data represent the weighted average of two pickings, when a second picking was necessary, at each location. It can readily be seen that differences in trash content between treatments in the wagon sample had been sharply reduced by the time the cotton reached the gin stand. For example, at location 2 in 1955 a trash content difference of 3.5 percent in the wagon was reduced to 0.4 percent at the feeders. In the second picking the trash content of the wagon sample ran as high as 26 percent, but it was never higher than 4 percent when the cotton reached the stands. Modern gins do an excellent job of removing foreign matter from seed cotton, and as a result, much of the difference between treatments was eliminated during this cleaning process.

After cotton is ginned, some foreign matter or trash remains in the lint. Shirley Analyzer data reflecting the foreign matter content of lint cotton for the two treatments are shown in table 13. Although there is a definite tendency for defoliated cotton to contain less trash in the first picking, differences between the two are usually small (appendix table 1). Averaging all test locations, these differences were 0.53 percent in 1953; 0.68 percent in 1954; and 0.74 percent in 1955. Weighted averages for the 3-year period indicates a difference of 0.51 percent in trash content in favor of defoliation. This amounts to about 2.5 pounds of trash per bale.

According to official standards, the difference in trash content between middling and strict low middling grades is 1.4 percent. This amounts to about 6.7 pounds of trash per bale. The difference between strict low middling and low middling grades amounts to 2.5 percent, or 12 pounds per bale. Although the differences in trash content reflected in table 13 would not usually be great enough to affect the value of a bale of cotton of typical grade it could materially affect the value of cotton that is marginal between grades.

The presence of foreign matter in cotton is one of the factors used to determine its grade and value. So its effect on quality would be recognized and evaluated in normal procedures for marketing the crop. Then, for all practical purposes, the effect of defoliation on quality can be determined by a comparison of the actual selling price of cotton receiving the two treatments.

Presented in table 14 are differences in value of lint per pound between undefoliated and defoliated cotton. Prices used were government loan values with interpolations for split grades. The prices indicated here are the combined values of two pickings weighted by the pounds of lint harvested each time. A strong tendency for defoliation to improve grade is evidenced by the fact that in 14 of the 18 cases studied, grade improvements ranging up to more than $13 per bale resulted from use of the practice. Although the grade improvements were usually nominal, they were fairly constant. Averaging all locations, improvements associated with defoliation amounted to $0.30 per bale in 1953, $4.80 per bale in 1954, and $0.60 per bale in 1955. Over the 3-year period, defoliation increased the value of cotton by $1.80 per bale.

In addition to the effects of defoliation on cotton quality that would be noted and evaluated immediately in normal marketing procedures, there are possible effects on fiber quality indicative of improper defoliant application, that might not be recognized immediately. In any intensive study of the problem, it seemed advisable

Table 13. A comparison of the foreign matter content of lint cotton, undefoliated and defoliated treatments, 1953-55 and 3-year average.

Location number	Foreign matter content of lint cotton							
	1953		1954		1955		3-year average	
	Undef.	Def.	Undef.	Def.	Undef.	Def.	Undef.	Def.
	percent	percent	percent	percent	percent	percent	percent	percent
1.	5.73	5.75	7.15	6.44	----	----	6.44	6.10[1]
2.	3.97	3.64	3.71	2.88	5.96	4.68	4.55	3.73
3.	6.96	4.79	5.62	4.45	6.14	5.14	6.24	4.79
4.	4.84	4.02	5.18	4.32	6.42	4.65	5.01	4.17
5.	5.63	5.70	5.14	4.17	5.10	5.11	5.29	4.99
6.	6.55	5.70	4.47	4.92	----	----	5.51	5.31[1]
7.	3.70	4.06	----	----	5.38	5.70	3.70	4.06[1]
Average	5.34	4.81	5.21	4.53	5.80	5.06	5.25	4.74

[1] 2-year average.

Table 14. A comparison of quality as reflected in value of lint per pound and annual and average variations in value between defoliated and undefoliated cotton[1].

Location number	3-year average value in cents per pound		Annual and average variation in value between defoliated and undefoliated treatments			
	Undef.	Def.	1953	1954	1955	3-year Av.
	cents	cents	cents	cents	cents	cents
1.	30.68	31.14[2]	+.13	+ .79	----	+ .46[2]
2.	32.24	32.26	—.43	— .40	+.87	+ .02
3.	33.18	33.42	+.27	+1.05	—.61	+ .24
4.	31.47	32.62	+.33	+2.74	+.38	+1.15
5.	31.75	32.07	—.50	+1.45	+.01	+ .32
6.	32.90	33.11[2]	+.25	+ .16	----	+ .21[2]
7.	32.26	32.41[2]	+.35	----	+.05	+ .15[2]
Average			+.06	+ .96	+.12	+ .36

[1] U. S. Government loan prices for lint.
[2] 2-year average.

to investigate the possibility of these effects showing up at some later time. For this reason, further measures of the effects of defoliation on fiber and seed properties were studied.

The effects of defoliation on fiber fineness as measured by micronaire readings are presented in table 15. These data represent weighted averages of two pickings, where two pickings were necessary, at each location. Although considerable differences in fineness of fiber occurred among locations, no consistent differences between treatments were found. Differences in fineness of fiber between pickings were alsc fairly wide (see appendix table 2) but again no significant differences between treatments were evident. The measurements indicated in table 15 represent fiber fineness for this type cotton that is readily acceptable to spinners.

Shown in table 16 are the effects of defoliation on tensile strength as determined by Pressley strength tests. These data also represent weighted averages of two pickings, where two pickings were necessary, at each location. Although wide variations occurred among years and to some extent among locations (appendix table 3), no consistent differences are noted between treatments. According to these data, defoliation apparently does not affect fiber tensile strength.

Presented in table 17 are the effects of defoliation on fiber or staple length as determined by Fibrograph measurements and stated in terms of the "upper half mean" fiber length. The indicated values in the table are weighted averages of two pickings at each location. Although the length of the fiber varies between first and second pickings and some variation occurs among locations and among years (appendix table 4), there is no evidence of any differences between treatments. It must be concluded that defoliation had no effect on fiber length under conditions existing for these tests.

As a measure of the effect of defoliation on cottonseed, germination tests were run on seed from defoliated and undefoliated cottons. The results of these tests for 1955 are shown in table 18. Differences between treatments were small and inconsistent. As noted in the table, the average difference in germination between defoliated and undefoliated cotton was less than 1 percent.

Earliness

The effect of defoliation on earliness of harvest, as measured in terms of the

Table 15. A comparison of micronaire readings for fiber fineness, undefoliated and defoliated cotton, 1953-55 and 3-year average.

Location number	Micronaire Units							
	1953		1954		1955		3-year average	
	Undef.	Def.	Undef.	Def.	Undef.	Def.	Undef.	Def.
1.	4.3	4.3	4.2	4.0	...	...	4.3	4.2[1]
2.	4.6	4.4	5.0	4.8	4.3	4.0	4.6	4.4
3.	3.8	3.6	4.1	4.0	4.2	4.4	4.0	4.0
4.	4.3	4.3	4.5	4.6	4.6	4.4	4.5	4.5
5.	4.1	3.8	4.4	4.7	4.2	4.1	4.2	4.2
6.	4.0	4.0	4.1	4.2	...	...	4.1	4.0[1]
7.	4.5	4.6	....	....	4.1	4.2	4.4	4.4[1]
Average	4.2	4.1	4.4	4.4	4.3	4.2	4.3	4.2

[1] 2-year averages.

Table 16. A comparison of Pressley ratings for tensile strength, undefoliated and defoliated cotton, 1953-55 and 3-year average.

Location number	Pressley ratings in thousand pounds per square inch							
	1953		1954		1955		3-year average	
	Undef.	Def.	Undef.	Def.	Undef.	Def.	Undef.	Def.
1.	79	77	84	87	....	....	82	82[1]
2.	82	83	90	88	97	96	89	89
3.	73	73	86	84	97	98	85	85
4.	77	76	84	85	98	91	86	84
5.	81	79	84	86	99	98	88	87
6.	83	82	90	88	...		87	85[1]
7.	82	84	....	....	101	99	89	90[1]
Average	80	79	86	86	98	96	87	86

[1] 2-year averages.

Table 17. A comparison of Fibrograph measurements of fiber length (upper half mean), undefoliated and defoliated cotton, 1953-55 and 3-year average.

Location number	Fiber length (upper half mean) in inches							
	1953		1954		1955		3-year average	
	Undef.	Def.	Undef.	Def.	Undef.	Def.	Undef.	Def.
1.	1.05	1.08	1.04	1.04	......	......	1.05	1.06[1]
2.	1.05	1.06	1.03	1.03	1.06	1.06	1.05	1.05
3.	1.13	1.12	1.04	1.04	1.12	1.10	1.10	1.09
4.	1.09	1.07	1.05	1.04	1.07	1.09	1.07	1.07
5.	1.09	1.12	1.08	1.04	1.08	1.09	1.08	1.08
6.	1.06	1.08	.99	.98	......	......	1.02	1.04[1]
7.	1.04	1.02	......	......	1.08	1.05	1.05	1.03[1]
Average	1.07	1.08	1.04	1.03	1.07	1.08	1.06	1.06

[1] 2-year averages.

Table 18. A comparison of cottonseed germination, undefoliated and defoliated cotton, 1955.

Location number	Undefoliated	Defoliated	Variation between defoliated and undefoliated
	percent	percent	percent
2.	87.0	88.1	+1.1
3.	90.9	92.0	+1.1
4.	86.8	90.0	+3.2
5.	92.1	90.8	—1.3
7.	91.4	91.6	+ .2
Average	89.6	90.5	+ .9

Table 19. The effect of defoliation on earliness of harvest, 1953-55 average, and annual and average variations in earliness between defoliated and undefoliated cotton.

	Percentage of lint cotton harvested at first picking					
	1953-55 average		Annual and average variation in earliness between defoliated and undefoliated treatments			
Location number	Undef.	Def.	1953	1954	1955	3-year average
	percent	percent	percent	percent	percent	percent
1.	81.4	82.4	—4.3	+6.5	---	+1.0[1]
2.	85.3	86.3	—3.6	+2.9	+3.8	+1.0
3.	90.0	92.0	+4.1	+1.1	+1.0	+2.0
4.	94.5	94.7	0.0	+ .4	----	+ .2[1] [2]
5.	79.8	84.4	+2.5	+7.1	+4.1	+4.6
6.	75.4	75.6	—3.6	+4.1	----	+ .2[1]
7.	70.5	74.7	+4.2	----	----	+4.2[2] [3]
Average			— .1	+3.7	+3.0	+1.9

[1] 2-year average.

[2] Locations 4 and 7 had only one picking in 1955.

[3] One year only.

percentage of lint cotton harvested at the first picking, is shown in table 19. Although defoliation tends to improve earliness, the extent of this improvement is usually small. Over the 3-year period, 1.9 percent more of the defoliated than undefoliated cotton was harvested at first picking. Under conditions existing for these tests, the data fail to bear out the popular conception that defoliation has a marked effect on the rate at which cotton opens.

Mechanical Picker Efficiency

Mechanical picker efficiency was measured by gleaning a number of random samples of 100 linear feet of row behind the machine at each picking operation in each treatment. It is expressed as the percentage of open cotton harvested by the machine. In 1953 and 1954, gross weights of the gleanings were used to compute efficiency. In 1955, however, the trash content of the gleanings was determined and clean cotton weights were used to make the efficiency computations.

Picker efficiency comparisons on defoliated and undefoliated cottons are shown in table 20. Over the 3-year period dealing with 18 locations there were 11 gains and 7 losses in picker efficiency associated with defoliation. The gains ranged up to 4 percent and the losses down to 1.5 percent. The average net effect over the period was a gain in efficiency with defoliation of 0.62 percent or, in cotton yielding a bale per acre, an equivalent savings of about 3 pounds of lint cotton per acre.

On careful examination of these figures and their relationship to plant growth and plant condition, there appear to be other factors that have considerably more effect on picker efficiency than defoliation.

Picking Time Required

In an effort to determine the effect of defoliation on picking time required, detailed records of the actual operating time of the machine in each treatment were made. Allowances were made for all stoppages. Results of these findings are presented in table 21. The locations were well divided with respect to this factor, with about half showing a reduction in picking time with defoliation and half showing an increase. Averaging the findings at all locations, there was a reduction of picking time, associated with defoliation of 0.4 of a minute per acre in 1953 and no difference in 1954. The 2-year average indicates a saving of 0.2 of a minute per acre through use of the practice. These data indicate that defoliation has no apparent effect on picking time, and this measure of the effects of defoliation was eliminated from the test after 1954.

Economic Evaluations

In order to summarize the effects of the factors under consideration, a dollar and cents value was assigned to each. Briefly, these values were derived as follows: Quality represents the weighted average grades obtained valued at government loan rates. Earliness is accounted for in establishing quality. Picker efficiency is expressed in the gain or loss in lint per acre valued at the appropriate price. Picker operating time is the difference in time required to harvest an acre expressed in minutes and multiplied by $0.13. The figure of $0.13 per minute for picker time is established from a prev-

Table 20. A comparison of mechanical cotton picker efficiency, 1953-55 average, and annual and average variations in picker efficiency between defoliated and undefoliated cotton.

	Percentage of open cotton harvested					
	1953-55 average		Annual and average variation in picker efficiency between defoliated and undefoliated cotton			
Location number	Undef.	Def.	1953	1954	1955	3-year average
	percent	percent	percent	percent	percent	percent
1.	90.97	90.20	—1.4	— .13		— .77
2.	86.24	89.34	+4.0	+3.50	+1.80	+3.10
3.	94.23	94.74	+1.3	— .28	+ .50	+ .51
4.	92.31	93.41	+ .8	+1.43	+1.07	+1.10
5.	92.66	93.28	+ .2	+2.35	— .69	+ .62
6.	87.72	88.10	+1.9	—1.14		+ .38
7.	85.46	84.84	— .4		— .84	— .62
Average			+ .9	+ .90	+ .37	+ .62

Table 21. A comparison of total time per acre required for machine harvesting, 1953-54 and annual and average variations in picking time required between defoliated and undefoliated cotton.

	1953-54 Average		Annual and average variation in picking time per acre required between defoliated and undefoliated cotton		
	Undef.	Def.	1953	1954	2-year average
	minutes	minutes	minutes	minutes	minutes
1.	160	175	+18	+12	+15
2.	154	145	—14	— 3	— 9
3.	171	170	0	— 1	— 1
4.	180	178	+ 1	— 4	— 2
5.	176	174	— 4	+ 1	— 2
6.	165	152	—20	— 5	—13
7.	171	187	+16	...	+16[1]
Average			— .4	0	— .2

[1] One year only.

Table 22. A costs and returns evaluation of specified measures of the effect of defoliation on mechanical harvesting of cotton, 1953[1].

Location number	Average cost of defoliation	Dollar evaluation of			Total returns	Net returns
		Quality	Picker Efficiency	Picker operating time		
	dollars	dollars	dollars	dollars	dollars	dollars
1.	2.70	+0.65	—2.24	—2.34	—3.93	—6.63
2.	2.70	—2.15	+6.40	+1.82	+6.07	+3.37
3.	2.70	+1.35	+2.08	0	+3.43	+0.73
4.	2.70	+1.65	+1.28	—0.13	+2.80	+0.10
5.	2.70	—2.50	+0.32	+0.52	—1.66	—4.36
6.	2.70	+1.25	+3.04	+2.60	+6.89	+4.19
7.	2.70	+1.75	—0.64	—2.08	—0.97	—3.67
Average	2.70	+0.28	+1.46	+0.06	+1.80	—0.90

[1] Assumes a lint yield of 500 pounds per acre.

Table 23. A costs and returns evaluation of specified measures of the effect of defoliation on mechanical harvesting of cotton, 1954.

Location number	Average cost of		Total cost	Dollar evaluations of changes in		Total returns	Net returns
	Defoliation	Yield reduction		Quality	Picker efficiency		
	dollars	dollars	dollars	dollars	dollars	dollars	dollars
1.	4.00	21.86	25.86	+ 7.53	—0.37	+ 7.16	—18.70
2.	4.00	4.98	8.98	— 2.55	+7.32	+ 4.77	— 4.21
3.	4.00	16.96	20.96	+ 8.75	— .80	+ 7.95	—13.01
4.	4.00	5.20	9.20	+23.76	+4.13	+27.89	+18.69
5.	4.00	3.74	7.74	+12.04	+6.36	+18.40	+10.66
6.	4.00	1.65	5.65	+ .83	—1.97	— 1.14	— 6.79
Average	4.00	9.06	13.06	+ 8.39	+2.44	10.84	— 2.28

ious study. As has been pointed out earlier, yields were not considered for this year. Results of this summary for 1953 are shown in table 22.

Net returns from the use of defoliation, after deducting costs of material and application, were obtained at 4 locations. These returns ranged from $0.10 to $4.19 per acre. At 3 locations, losses associated with use of the practice ranged from $3.67 to $6.63 per acre. On the average, at the 7 locations, defoliation, during this year, resulted in a net loss of approximately $0.90 per acre. In 1953, picker efficiency was the only factor under consideration that showed any appreciable effect from defoliation.

In 1954, the effect of defoliation on yield was included as a part of the economic evaluation. Reductions in yield were valued at the quality designations of check plots. Otherwise, values for the measures considered were established in the same way as in 1953. These results for 1954 are shown in table 23.

Net returns from the use of defoliation, after deducting material and application costs and adjusting for reductions in yield, were obtained at 2 locations. These returns were sizable, amounting to $10.66 and $18.69 per acre. These two instances, as will be pointed out later, represented situations under which returns to defoliation could normally be expected. At the other 4 locations, losses ranging from $4.71 to $18.70 per acre were sustained. For all locations, the net loss sustained by defoliation averaged roughly $2.30 per acre.

Reductions in yield were the most important single factor affecting returns from defoliation in 1954. These reductions ranged from $1.65 to almost $22.00 per acre and averaged slightly more than $9.00 per acre at the 6 locations studied. On the other hand, quality was considerably improved when the practice was followed. Results ranged from a loss of $2.55 per acre, in one instance, to a gain of almost $24.00 per acre in another. In fact, had yields not been affected net returns to defoliation would have accrued at all locations studied.

In 1955, picker operating time, for reasons mentioned earlier, was eliminated as a consideration in the tests. A summary of the cost and returns information on defoliation for 1955 is presented in table 24. As pointed out earlier, costs of materials and application were very high in 1955 because of the necessity for reapplications at many locations. These costs averaged $5.30 in 1955 compared with $4.00 in 1954 and $2.70 in 1953. Costs were unusually low in 1953 because of the widespread use of dust defoliants, which are considerably cheaper.

Reductions in yield were not important in 1955. They averaged only slightly above $1.25 per acre. Although quality and picker efficiency among locations varied considerably, on the average, defoliation had little effect on these factors. With regard to net returns, losses were sustained at 4 of the 5 locations studied in 1955. These losses averaged about $5.00 per acre, which is virtually equivalent to the material and application cost of the defoliant.

A summary of the costs and returns

Table 24. A cost and returns evaluation of specified measures of the effect of defoliation on mechanical harvesting of cotton, 1955.

Location number	Average cost of		Total cost	Qualtiy	Picker efficiency	Total returns	Net returns
	Defoliation	Yield reduction		Dollar evaluations of changes in			
	dollars	dollars	dollars	dollars	dollars	dollars	dollars
1.	- -	- -	- - -	----	----	----	----
2.	5.30	2.77	8.07	+7.48	+4.91	+12.39	+ 4.32
3.	5.30	1.68	6.98	—5.00	+1.36	— 3.64	—10.62
4.	5.30	2.80	8.10	+1.50	+1.32	+ 2.82	— 5.28
5.	5.30	+5.44	+ .14	+ .80	—1.83	— 1.75	— 1.61
6.	----	----	----	----	----	----	----
7.	5.30	4.58	9.88	— .35	—1.93	— 2.28	—12.16
Average	5.30	1.28	6.58	+ .74	+ .77	+ 1.51	— 5.07

Table 25. A cost and returns evaluation of specified measures of the effect of defoliation on mechanical harvesting of cotton, 3-year average.

Location number	Average cost of		Total cost	Dollar evaluations of changes in		Total returns	Net returns
	Defoliation	Yield reduction		Qualtiy	Picker efficiency		
	dollars	dollars	dollars	dollars	dollars	dollars	dollars
1.[1]	4.00	21.86[2]	25.86	+4.09	—1.30	+ 2.79	—23.07
2.	4.00	3.88	7.88	+ .93	+6.21	+ 7.14	— .74
3.	4.00	9.32	13.32	+1.70	+ .88	+ 2.58	—10.74
4.	4.00	4.00	8.00	+8.97	+2.24	+11.21	+ 3.21
5.	4.00	+1.70	2.30	+3.46	+1.62	+ 5.08	+ 2.78
6.[1]	4.00	1.65[2]	5.65	+1.04	+ .54	+ 1.58	— 4.07
7.[1]	4.00	4.58[2]	8.58	— .88	—1.28	— 2.16	—10.74
Average	4.00	6.23	10.23	+2.76	+1.27	+ 4.03	— 6.20

[1] 2-year average.

[2] One year only.

data for the 3-year period of the study is presented in table 25. Reduction in yield was again the greatest single factor affecting returns from defoliation. Quality, and to a lesser extent, picker efficiency, tended to be improved with the use of the practice. However, on the average, gains from defoliation were not sufficient to offset reductions in yield and cost of defoliation. As a result, losses averaging more than $6.00 per acre were sustained over the period of the study. If the measured reductions in yield are removed from consideration and only cost of defoliation (one application), quality, and picker efficiency are considered, the average net return from the practice over the period of the study amounts to $0.22 per acre.

Information collected on the use of desiccants was not sufficient to permit a complete analysis. In general, however, the findings indicate that the use of desiccants tended definitely to reduce returns. In most instances observed, yields were lowered, quality reduced, and other factors adversely affected. The use of desiccants did not appear to be a substitute for defoliation under the conditions of these studies. Although desiccants have been used to a considerable advantage in stripper-harvest areas, apparently the only logical place for desiccants in the harvesting picture in rain-grown areas where the spindle picker is used, is in situations where weed, grass, and/or vine infestation is heavy and a "drying-up" action is needed prior to harvesting. Too, it has definite possibilities for "drying-up" second growth, when this growth is present in sufficient quantities to affect harvesting adversely.

Relationships at Individual Locations

Admittedly, these average returns from the use of defoliation do not supply the complete answer for evaluating the practice. They serve simply to point out that defoliation is not necessarily economically feasible under all conditions. More important are the relationships between climate and plant conditions and the effects of defoliation, measured in net returns, at individual locations.

1953 — At none of the locations were plants in an active state of growth at the time the defoliants were applied. And even though plant height, in some instances, was above normal and natural defoliation was relatively low, the foliage remaining on plants at all locations was extremely coriaceous. Drought-stressed plants with their tough and leathery foliage, do not present a situation in which material benefits can be expected from defoliation. This is borne out by the average returns indicated in table 25.

Some variation at individual locations did occur. For the most part, however, these variations, were due to picker efficiency and picker operating time, measures that were subsequently found to be greatly affected by factors other than defoliation. If these measures are eliminated from consideration, the consistent small losses occurring from the use of defoliation would be expected and realistic in light of plant condition. At locations 2 and 5 losses were somewhat greater than would be expected because of effects on quality. At location 2, considerable second growth was present at the second picking on the defoliated plot, which accounts for the difference in quality. At location 5, top leaves on the defoliated plants were burned and desiccated and failed to drop. This condition also resulted in differences in quality.

1954 — At locations 2 and 6, plant height was about 3 feet, active growth was not present and foliage density was barely medium. Natural defoliation was fairly high and the remaining foliage was tough and leathery from the effects of drought. Based on 1953 results and past observations, little if any benefit could be expected from defoliation under these conditions. This is borne out by the net returns indicated in table 23.

Growing conditions at location 3 were similar to conditions at 2 and 6, except that in late summer this cotton received an irrigation that caused considerable recovery from the effects of the drought. Nevertheless, by defoliation time the foliage showed evidence of stress and natural defoliation was high. If the reduction in yield had been only slight, this would still have been a borderline case from the standpoint of benefits from defoliation.

At locations 1 and 5, the plants were growing actively; plant height was about 5 feet; foliage density was heavy; plant condition was favorable; and natural defoliation was low. These locations would have been expected to show the greatest benefits from defoliation. The net return of more than $10 per acre at location 5 then appears to be reasonable. The loss at location 1 is difficult to explain. Even if the reduction in yield there had been no greater than the average, a loss of more than $5 per acre would have resulted. A possible explanation lies in the fact that quality for all treatments was low at this location. Since fractionation data show no unusual trash content for this cotton, it is possible that quality was influenced by some condition that defoliation could not be expected to affect.

Location 4 represents a rather unusual situation, although the plants were large, foliage density heavy and natural defoliation low, a relatively high state of maturity existed at the time of defoliation. An estimated 99-percent leaf drop was obtained on the defoliated plot. However, in the 16-day interval between defoliation and harvest, rainfall exceeded 2 inches and differences in quality appeared. The results are highly noticeable in the $28 per acre quality differential. Explanation of the differences in quality appear to lie in the fact that leaves remaining in the undefoliated plot prevented rapid drying of the cotton, thereby causing some lint deterioration. In the defoliated plot, where few leaves remained, drying of the cotton took place rapidly and lint deterioration was inhibited or retarded. This protection of quality through defoliation, when rains fell between defoliation and harvest, occurred again during 1955, but the differences were not so striking, probably because of the reduced differential between leaves remaining on the defoliated and undefoliated treatments.

1955 — At location 3, plant height was about 3½ feet, which was low for the area; active growth was not present; and foliage density was only medium. The plants were mature and natural defoliation was high. Based on past results, little could be expected from defoliation under these conditions. At this location, a loss of $10 per acre was sustained.

At location 4, plant height was 5½ feet; foliage density was heavy; and plants were in active growth. However, damage from boll weevils was heavy and no cotton was harvested from the top half of the stalk. The leaves on this part of the stalk were particularly difficult to remove. Two applications of defoliant were necessary to effect a 90-percent leaf drop and by that time natural defoliation was high. Net returns amounted to a $5 loss.

Locations 5 and 7 had tall stalks and dense foliage, but 5 required two applications and by harvest time there was only a 25-percent leaf-drop differential. Returns here were near the margin. By harvest time there was only a 5-percent difference in leaf drop at location 7, and a loss of $12 per acre was sustained.

At location 2, conditions were favorable for defoliation. Plants were large and foliage dense. Two inches of rain occurred between defoliation and harvest. Net returns were improved by more than $4 per acre. Had not two applications of defoliant been required, delaying the time of harvest, even greater returns might have been expected at this location.

In recapitulation, these comparisons indicate that conditions exist under which marked economic returns will accrue from the practice of defoliation. These conditions are characterized by rank succulent growth and heavily fruited cotton which matures in the presence of adequate moisture. By the same token, conditions frequently exist under which no such economic return can be expected. These are characterized by small, drought-stressed, heavily fruited plants, from which a large percentage of the leaves have fallen because of natural causes.

In addition, there are certain factors that influence the returns from defoliation, as outlined above. Too early defoliation resulting in yield reductions, excessive boll weevil or other insect damage resulting in restriction of the boll load to certain sections of the plant, and an exceedingly dry picking season are examples of conditions that tend to act adversely on chances of defoliation resulting in economic benefits.

On the other hand, as found in 1954 and 1955, the occurrence of rains between defoliation and harvest, conditions conducive to boll rot, and low rates of natural defoliation are conditions that will show a tendency to improve the benefits derived from defoliation.

Summary

Defoliation, in conjunction with mechanical harvesting of cotton, has become an important practice on farms in the cotton belt. Annually about 3 million acres are treated for this purpose. The study reported here was intended to examine the practice with respect to its economic feasibility.

During the conduct of the study in 1953-55, annual rainfall was normal, except in 1954. However, distribution of rainfall during the growing season was usually below normal and inadequate. Temperatures were higher than normal in 1953 and 1954 and close to normal in 1955. In general, weather in all 3 years was conducive to rapid early-season growth, followed by drought during the flowering and fruiting periods. The picking season tended to be drier than usual; thus reducing the adverse effect of moisture on quality.

A wide range of plant conditions at the time of defoliation was encountered over the period of the study. In some instances only were the plants in a state of active growth. Plant height varied among locations and years from 30 inches to 6 feet. Foliage density ranged from light to very heavy and the extent of natural defoliation varied from 15 to 60 percent. Open cotton at time of defoliation ranged from 50 to 80 percent.

Plant conditions at the time of first picking also varied widely among years and among locations. Natural leaf drop in the undefoliated plots ranged from 30 to 85 percent at this time. Defoliation on the treated plots varied from 50 to 99 percent and net chemical defoliation ranged from 5 to 65 percent. Grass and vines, second growth, and boll rot were not present in sufficient quantities to merit consideration during the 3 years of the study.

Net returns to defoliation over the entire test period ranged from a profit of $3.21 per acre to a loss of more than $23.00 per acre with 5 of the 7 locations studied indicating a loss.

The largest contributing factor to the losses was reduction in yield, which amounted to as much as $20 per acre. The greatest item of gain was reflected in quality where increases as high as $9 per acre resulted from the use of defoliation. Losses for the seven locations, over the 3-year period, averaged $6 per acre. If the measured reductions in yield are removed from consideration and only the cost of defoliation (one application), quality, and picker efficiency are considered, the average net return from the practice over the period of study amounted to $0.22 per acre.

Of more importance than these average returns are the relationships between climate and plant conditions and the effects of defoliation, measured in net returns, at individual locations.

These comparisons indicate that conditions exist under which marked economic returns will accrue from the practice of defoliation. These conditions are characterized by rank growth and heavily fruited cotton which matures in the presence of adequate moisture. By the same token, conditions frequently exist under which no such economic return can be expected. These are characterized by small, drought stressed, heavily fruited plants, from which a large percentage of leaves have fallen due to natural causes.

In addition, there are certain factors that influence the returns from defoliation, as outlined above. Too early defoliation resulting in yield reductions, excessive boll weevil or other insect damage resulting in restriction of the boll load to certain sections of the plant, and a very dry picking season are examples of conditions that tend to prevent defoliation from resulting in economic benefits.

As found in 1954 and in 1955, however, the occurrence of rains between defoliation and harvest, conditions conducive to boll rot, and low rates of natural defoliation tend to improve the benefits derived from defoliation.

Sufficient information is not available on which to even hazard a guess as to the frequency with which these various criteria are likely to occur.

In retrospect then, for the two extremes in plant condition the decision as to whether or not to defoliate becomes rather simple. For those situations lying between the extremes, the decision must still be reached by weighing the presence and intensity of the factors outlined above as they occur in each field each year.

Appendix Tables

Appendix table 1. A comparison of foreign matter content of lint, first and second pickings, undefoliated and defoliated cotton, 1953-55 and 3-year average.

Location number	Foreign matter content of lint							
	1953		1954		1955		3-year average	
	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.
	percent	percent	percent	percent	percent	percent	percent	percent
1. 1st pick	5.59	5.04	6.37	7.23	----	----	5.98	6.14
2nd pick	6.33	7.52	6.95	6.82	----	----	6.64	7.17
Av.	5.75	5.73	6.44	7.15	----	----	6.10	6.44
2. 1st pick	3.60	4.26	2.72	3.75	4.46	5.77	3.59	4.59
2nd pick	3.85	2.11	4.18	3.49	6.19	6.60	4.74	4.07
Av.	3.64	3.97	2.88	3.71	4.68	5.96	3.73	4.55
3. 1st pick	4.34	6.65	4.06	5.30	4.57	5.50	4.32	5.82
2nd pick	10.24	9.35	8.42	8.49	12.49	13.39	10.38	10.41
Av.	4.79	6.96	4.45	5.62	5.14	6.14	4.79	6.24
4. 1st pick	3.75	4.53	4.06	4.86	4.65	6.42	4.15	5.27
2nd pick	8.04	9.59	10.07	11.53	----	----	9.06	10.56
Av.	4.02	4.84	4.32	5.18	4.65	6.42	4.17	5.01
5. 1st pick	5.42	5.41	3.74	4.93	4.90	4.74	4.69	5.03
2nd pick	6.79	6.37	6.12	5.76	7.38	7.69	6.76	6.61
Av.	5.70	5.63	4.17	5.14	5.11	5.10	4.99	5.29
6. 1st pick	5.48	6.22	5.04	4.22	----	----	5.26	5.22
2nd pick	6.37	7.77	4.51	5.12	----	----	5.44	6.44
Av.	5.70	6.55	4.92	4.47	----	----	5.31	5.51
7. 1st pick	3.87	3.46	----		5.70	5.38	4.78	4.42
2nd pick	4.63	4.29	----	----	----	----	4.63	4.29
Av.	4.06	3.70	----	----	----	----	4.06	3.70
Av. 1st pick	4.58	5.08	4.33	5.05	4.86	5.56	4.68	5.21
2nd pick	6.61	6.71	6.71	6.87	8.69	9.23	6.81	7.08
Av.	4.96	5.40	4.62	5.33	5.22	6.10	4.74	5.25

Appendix table 2. A comparison of micronaire readings for fiber fineness, first and second pickings, undefoliated and defoliated cotton, 1953-55 and 3-year average.

Location number	1953		1954		1955		3-year average	
	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.
1. 1st pick	4.5	4.6	4.1	4.2	----	----	4.3	4.5[1]
2nd pick	3.4	3.6	3.6	4.0	----	----	3.5	3.8
Av.	4.3	4.3	4.0	4.2	----	----	4.2	4.3
2. 1st pick	4.5	4.7	4.9	5.0	4.1	4.3	4.5	4.7
2nd pick	3.8	4.3	4.4	4.7	3.2	4.1	3.8	4.4
Av.	4.4	4.6	4.8	5.0	4.0	4.3	4.4	4.6
3. 1st pick	3.7	3.9	4.0	4.1	4.4	4.2	4.0	4.1
2nd pick	2.9	3.0	3.6	3.8	4.2	4.1	3.6	3.6
Av.	3.6	3.8	4.0	4.1	4.4	4.2	4.0	4.0
4. 1st pick	4.4	4.4	4.6	4.5	4.4	4.6	4.5	4.5
2nd pick	3.2	3.4	4.0	4.2	----	----	3.6	3.8
Av.	4.3	4.3	4.6	4.5	----	----	4.5	4.5
5. 1st pick	4.0	4.2	4.9	4.6	4.1	4.2	4.3	4.3
2nd pick	3.0	3.6	3.6	3.8	3.9	4.2	3.5	3.9
Av.	3.8	4.1	4.7	4.4	4.1	4.2	4.2	4.2
6. 1st pick	4.3	4.2	4.2	4.0	----	----	4.2	4.1[1]
2nd pick	3.2	3.4	4.1	4.4	----	----	3.6	3.9
Av.	4.0	4.0	4.2	4.1	----	----	4.0	4.1
7. 1st pick	4.6	4.6	----	----	4.2	4.1	4.4	4.4[1]
2nd pick	4.6	4.4	----	----	----	----	4.6	4.4
Av.	4.6	4.5	----	----	----	----	4.4	4.4
Av. 1st pick	4.3	4.4	4.4	4.4	4.2	4.3	4.3	4.4
2nd pick	3.4	3.7	3.9	4.2	3.8	4.1	3.7	4.0
Av.	4.1	4.3	4.3	4.4	4.2	4.3	4.2	4.3

[1] 2-year averages.

Appendix table 3. A comparison of Pressley ratings for tensile strength, first and second pickings, undefoliated and defoliated cotton, 1953-55 and 3-year average.

Pounds per square inch

Location number	1953		1954		1955		3-year average	
	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.
	1000	1000	1000	1000	1000	1000	1000	1000
1. 1st pick	77	78	88	85	...	...	82	82
2nd pick	78	81	84	79	...	...	81	80
Av.	77	79	87	84	...		82	82
2. 1st pick	84	83	88	90	96	97	89	90
2nd pick	76	78	88	87	95	96	86	87
Av.	83	82	88	90	96	97	89	89
3. 1st pick	73	73	84	86	98	97	85	85
2nd pick	76	77	84	81	95	98	85	85
Av.	73	73	84	86	98	97	85	85
4. 1st pick	76	77	85	84	91	98	84	86
2nd pick	77	78	85	80	...	...	81	79
Av.	76	77	85	84	...	...	84	86
5. 1st pick	78	80	86	85	98	99	87	88
2nd pick	82	83	86	82	96	99	88	88
Av.	79	81	86	84	98	99	87	88
6. 1st pick	82	83	90	91	...	...	86	87
2nd pick	82	83	83	89	...	...	82	86
Av.	82	83	88	90	...		85	87
7. 1st pick	84	82	...		99	101	92	92
2nd pick	83	82	...	...	...	...	83	82
Av.	84	82	...	...			90	89
Av. 1st pick	79	79	87	87	96	98	87	88
2nd pick	79	80	85	83	95	98	86	87
Av.	79	79	87	86	96	98	87	88

Appendix table 4. A comparison of "upper half mean" fiber length as determined by Fibrograph analysis, first and second picking, undefoliated and defoliated cotton, 1953-55 and 3-year average.

Location	1953		1954		1955		3-year average	
	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.	Defol.	Undefol.
	inches	inches	inches	inches	inches	inches	inches	inches
1. 1st. pick	1.09	1.06	1.05	1.06			1.07	1.06
2nd pick	1.03	1.02	.96	.98	...		1.00	1.00
Av.	1.08	1.05	1.04	1.04			1.06	1.05
2. 1st pick	1.08	1.06	1.03	1.04	1.07	1.06	1.06	1.05
2nd pick	1.00	1.02	1.00	1.00	1.00	1.06	1.00	1.03
Av.	1.06	1.05	1.03	1.03	1.06	1.06	1.05	1.05
3. 1st pick	1.13	1.14	1.05	1.05	1.11	1.13	1.10	1.11
2nd pick	1.03	1.09	.99	1.00	1.04	1.01	1.02	1.03
Av.	1.12	1.13	1.04	1.04	1.10	1.12	1.09	1.10
4. 1st pick	1.07	1.09	1.04	1.05	1.09	1.07	1.07	1.07
2nd pick	1.02	1.03	.96	.98	...		.99	1.00
Av.	1.07	1.09	1.04	1.05	1.09	1.07	1.07	1.07
5. 1st pick	1.13	1.10	1.03	1.08	1.09	1.08	1.08	1.09
2nd pick	1.06	1.07	1.06	1.07	1.06	1.04	1.06	1.06
Av.	1.12	1.09	1.04	1.08	1.09	1.08	1.08	1.08
6. 1st pick	1.09	1.06	.99	1.00			1.04	1.03
2nd pick	1.07	1.05	.96	.96		...	1.02	1.00
Av.	1.08	1.06	.98	.99			1.04	1.02
7. 1st pick	1.02	1.04		...	1.05	1.08	1.04	1.06
2nd pick	1.01	1.04	...				1.01	1.04
Av.	1.02	1.04	...	...	1.05	1.08	1.03	1.05
Av. 1st pick	1.09	1.08	1.03	1.05	1.08	1.08	1.07	1.07
2nd pick	1.03	1.05	.99	1.00	1.03	1.04	1.02	1.03
Av.	1.08	1.07	1.03	1.04	1.07	1.07	1.06	1.06

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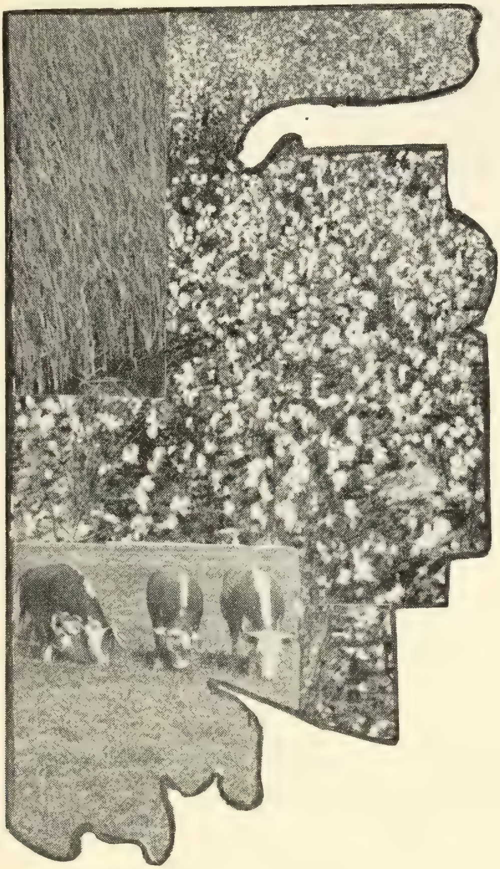

Leflore County Soils

MISSISSIPPI STATE COLLEGE

AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

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FOREWORD

Leflore County is an agricultural area and most of its wealth comes from the soil. Actual crop yields account for a major share of the money brought into the county each year, while livestock and forest products account for a minor share. The storage, further refining, and distribution of these products of the land add to the income of the county. The well being of the people and the economic strength of Leflore County lies in the intelligent use and management of its soils. A sound knowledge of the soil is important to the man who earns his living from this source.

This bulletin has been prepared to accompany the soil maps as a summary of the soil survey of Leflore County. The suggested management practices and land uses are based on field experiments, observation, field studies, and the experience of good farmers.

It is hoped that this report may help you to determine (1) what soils you have on your farm, and the general nature of each; (2) what are the capabilities and limitations of each soil type, thus helping you to use each acre for its best adapted use; (3) the value of your soil and the importance of its wise use and management; and (4) how to obtain efficient and abundant production on a sustained basis.

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*These surveyors spent only a portion of their time in Leflore County.

Area Inspected by: I. L. Martin, Senior Soil Correlator. Soil Conservation Service United States Department of Agriculture

The soil survey of Leflore County, Mississippi, is a cooperative contribution from the

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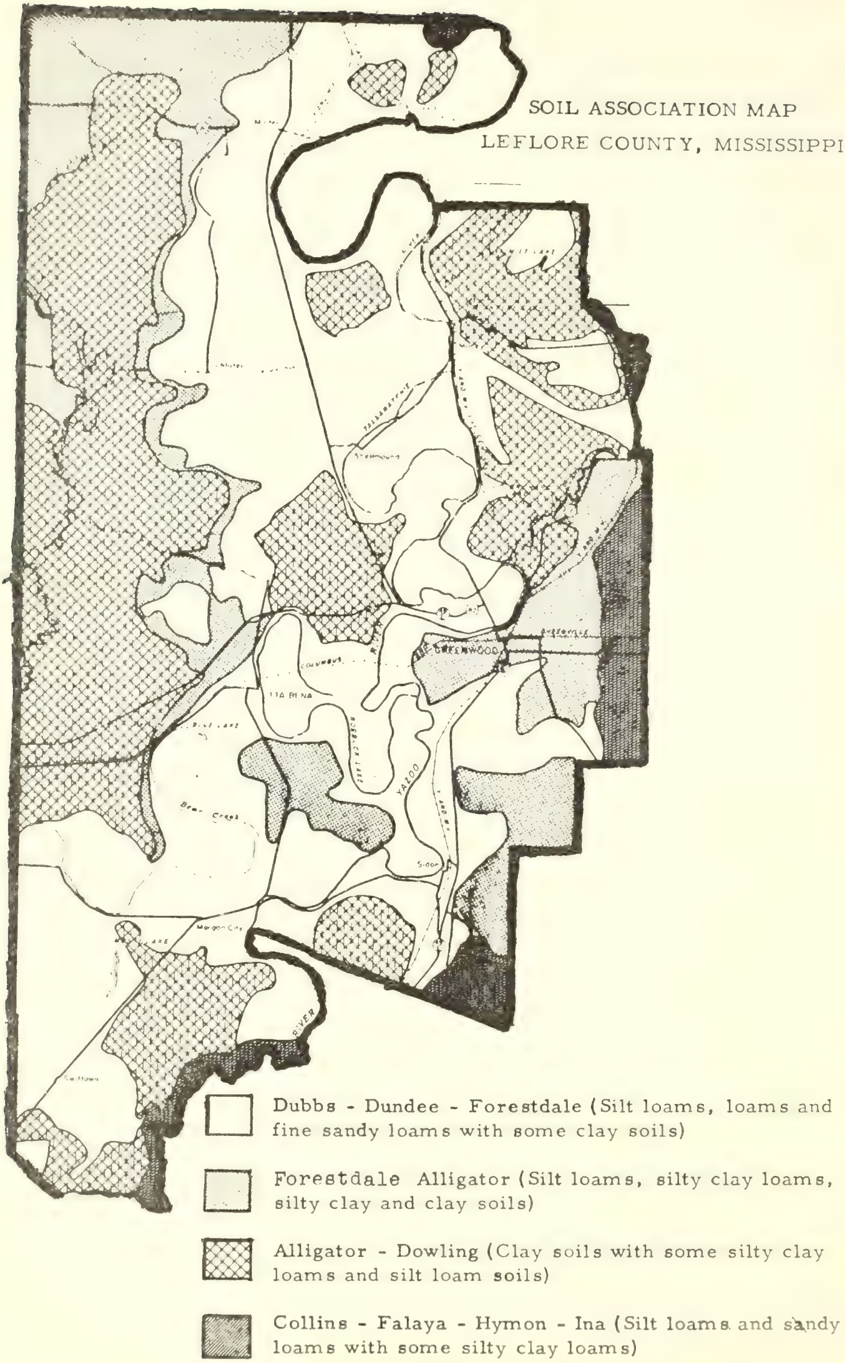
[1] Some of the field work was done while Soil Survey was administered by the Bureau of Plant Industry, Soils, and Agricultural Engineering. The administration of Soil Survey was transferred to the Soil Conservation Service on November 15, 1952.


GREENWOOD
ITTA BENA
COLUMBUS
ROEBUCK LAKE
YAZOO
Bear Creek
Sidon
Morgan City
RIVER
TALLAHATCHIE

SOIL ASSOCIATION MAP
LEFLORE COUNTY, MISSISSIPPI

☐ Dubbs - Dundee - Forestdale (Silt loams, loams and fine sandy loams with some clay soils)

░ Forestdale Alligator (Silt loams, silty clay loams, silty clay and clay soils)

▦ Alligator - Dowling (Clay soils with some silty clay loams and silt loam soils)

▓ Collins - Falaya - Hymon - Ina (Silt loams and sandy loams with some silty clay loams)

Leflore County Soils

By WALTER E. KEENAN

The primary objective of this report is to assist planters of Leflore County achieve efficient sustained production on their individual fields and farms.

As an aid to this end, an inventory of your soils and their general features has been made. The results are recorded on your soils map. This report contains information that will help you interpret your map. By carefully studying your soils map, the data given about each soil, and the suggested management practices presented in this report, you will be in a better position to appraise your soil resources and make them serve you better.

Three (3) steps are necessary to this end:

1. GET A MAP OF YOUR FARM

You have paid for these maps through county, state, and federal taxes. They are available to you at no further cost. The maps may be obtained through your County Agent or the Leflore County Soil Conservation office.

2. STUDY THE FACTORS THAT HAVE INFLUENCED YOUR SOILS MOST.

Such factors as parent materials, relief and drainage, vegetation, climate, age, and past agriculture are discussed beginning on this page. A knowledge of their influence on your soils will give you a better understanding of some of the important soil properties.

3. KNOW YOUR SOILS AND PLAN THEIR USE.

The common symbols on page 11 are used to show roads, railroads, streams, drainage ditches, houses, churches, schools and other general features of the area. Most important of all, each separate area of soil is indicated on the map by a symbol composed of numbers and letters. Each of these numbers and letters shows a specific characteristic or condition of the soil. Learn what the numbers and letters in your soil symbols mean by studying the discussion on page 10 and the diagram on page 12.

Beginning on page 13 some good uses of the soils maps are discussed. To determine management groups in which your soils are located and the page number on which they are discussed, use the index. For convenience in locating information, refer to the table of contents.

Factors That Have Influenced Your Soil

Have you ever asked yourself why your soils are as they are? The following six (6) factors are mostly responsible.

1. Parent Material

Stream borne sediments serve as parent materials of the soils of Leflore County. These materials have come from a multitude of soils, rocks and unconsolidated sediments of some 20 states including parts of Mississippi. There are wide ranges in the texture of this river alluvium because of differences in deposition. All of the sediments have been laid down by stream water either when quiet or in flood. As streams overflow their channels and water spreads out over the flood plain, coarser sediments are dropped first. Sands are commonly deposited in bands parallel to and near the channel. Low ridges thus formed are known as natural levees. As the floodwaters continue to spread, they move more slowly and finer sediments, such as silt, are deposited next, usually mixed with some sands and clays. When the flood has passed and water is left standing in the lowest parts of the flood plain, the finest sediments or clays settle out. These so-called slack-water clays do not settle until the water becomes still.

Many combinations of the above types of deposition occur as a result of the varying speeds and volumes of the floodwaters and the meandering patterns of the streams. Over the centuries streams have moved back and forth across much of the flood plain, sometimes cutting out natural levees which were laid down earlier, sometimes depositing sand on top of slack-water clays, or vice versa. As a result, the normal pattern of sediment distribution from a single channel has been partly or wholly truncated in many places and has had subsequent beds of alluvium placed on top of it. Many combinations of sediments resulting from the deposition of the simple patterns, one upon another, now exist in the county. However, fragments of former channels with their adjacent sandy natural levees, the very gently sloping bodies of medium-textured sediments, and slack-water clays can be found in a number of places.

2. Relief and Drainage

The relief of an area is one of the factors that regulates the surface runoff and erosion. Terms used to describe the relief of Leflore County are: Level, nearly level, gently sloping, and sloping. The largest percent of the county has nearly level (½ to 2 percent slopes) relief. Topographic relief is an important factor in soil formation, and the effect of the relief is evident in the soils of the county. The greater slopes have fast runoff, and the soils have formed under much less moisture than soils of the low areas which collect water from the adjoining land. The brownish color of the subsoils of Dundee, Dubbs, Bosket, and Beulah soils (soils that are found on the highest altitudes of the old natural levees) reflect good past drainage. Alligator, Dowling, and Forestdale soils (soils that are found in the low swags, low flat areas and the lowest elevation of the old natural levees) were formed under excessive moisture, and the mottled, gray color of the subsoils reflect this condition.

The altitude of the county ranges from 144 to 105 feet above mean gulf level. The highest points are on the old natural levees. The highest elevation is a point near Minter City, and the lowest is in the southern part of the county near the Humphreys County line. The elevation at Greenwood is 128 feet.

The Yazoo, Tallahatchie, Yalobusha, and Quiver Rivers all flow through Leflore County. Some years these streams overflow. While near flood stage, a portion of the water backs into lakes and bayous joining the streams. As a result, some land is covered with floodwaters for relatively long periods.

Bear Creek rises in Blue Lake. It flows through Three Mile, Lower Six Mile, and Four Mile Lakes. This net-work of lakes and streams drains much of the southwest section of the county. Water from the Yazoo River backs into Bear Creek, causing some small areas of land in this section to overflow.

Big Sand, Palusha, and Abiacha Creeks flow through the eastern part of the county. Teoc Creek enters the Yalobusha River near the Carroll County line. All of these rise in the bluffs on the east side of the flood plain. Floodwaters move down from the bluffs at high rates of speed until they reach the flood plain. As the waters cross the flood plain the speed is reduced, and as a result water backs up in the stream channels and canals and overflows the adjacent land. The flood waters move off quickly, but they cover the land for long enough periods to destroy growing crops. Some areas have been covered with detrimental deposits of coarse sand from these overflow waters.

3. Climate

The annual rainfall of Leflore County is 53.68 inches. The mean temperature is 64.5 degrees, but varies from -6 degrees to 111 degrees. Temperature and moisture regulate the organic matter content of soils. Where high temperatures prevail, soils usually have low amounts of organic

Table 1. Normal monthly and annual temperatures and precipitation at Greenwood, Leflore County, Mississippi.

Elevation 128 feet.

	Temperature[1]			Precipitation[2]		
Month	Average	Highest Recorded	Lowest Recorded	Average	Total Amount for Driest Year	Total Amount for Wettest Year
	°F	°F	°F	Inches	Inches	Inches
January	46.3	83	0	5.09	4.45	11.80
February	48.6	87	—6	4.77	1.99	7.60
March	57.1	92	20	5.82	1.85	3.29
April	64.4	97	28	5.70	7.18	5.20
May	72.3	103	37	4.79	.90	2.09
June	79.5	106	49	3.76	4.13	6.30
July	82.1	111	51	4.34	3.09	5.62
August	81.6	108	51	3.36	1.75	3.79
September	76.7	108	38	2.58	2.70	5.12
October	65.1	98	26	2.88	6.63	6.83
November	54.0	86	16	4.09	2.90	3.70
December	46.7	83	5	6.50	3.35	12.84
Annual	64.5	111	—6	53.68	40.92	74.18

U. S. Weather Bureau Reports.

[1] Average temperature based on a 58-year record, 1899 to 1956: Highest and lowest temperatures from a 33-year record, 1898 to 1930.

[2] Average precipitation based on a 59-year record, 1898 to 1956; Wettest and driest years based on a 52-year record, 1902 to 1953.

Killing Frost Average last in spring.......... Mar. 24
Average first in fall.......... Oct. 31
Average number of days without killing frost.......... 221

matter. Soils in areas of low temperature usually have high amounts of organic matter. With the high spring, summer, and fall temperatures of this area, most soils have a low organic matter content. However, soils formed on the slackwater deposits (clay) in general have somewhat higher organic matter content than those formed on the natural levees (sandy soils).

Usually, soils formed under humid, warm-temperate climates are strongly weathered, leached, and of low fertility. The soils of Leflore County are geologically young, and time has not yet permitted strong weathering of the sediments in place. However, leaching has progressed to the point that all soils in the county are strongly to slightly acid.

See Table 1 for summary of past weather conditions for Leflore County.

4. Vegetation

The first settlers found cover of dense forest broken occasionally by canebrakes. Dense stands of cypress filled the swampy areas, whereas hardwood stands covered most of the better drained soils and many of the wet ones. On the higher ridges were chiefly hickory, pecan, post oak, blackgum, and winged elm. In the low areas that were wet but not swampy, the principal trees were tupelo gum, sweetgum, soft elm, green ash, hackberry, cottonwood, overcup oak, and willow oak. These differences in native vegetation seem to have been associated mainly with differences in drainage. Only the major differences in the native vegetation are reflected to any extent in the soils, probably because of the short time the sediments have been in place.

Practically all of the land on the natural levees, and much of it on the slackwater deposits that could be drained has been cleared of its native vegetation. Approximately 80 percent of the total area of the county has been cleared.

Removal of the forest, cultivation of the soils, introduction of new species of plants, building of levees and dams for flood protection, and the artificial improvement of natural drainage will be reflected in the direction and rate of soil formation in the future. Few results of these changes can as yet be seen, and some may not be evident for many centuries. However, as a result of the activities of man, the soils of Leflore County are changing.

5. Age

As soon as the parent materials from which soils are derived are laid down, they are subjected to various weathering forces, and the processes of soil formation start. Although all soils in Leflore County are relatively young, there are differences in the lengths of time they have been in place. Parent material that has been in place the longest has been influenced most by relief and drainage, climate, and vegetation. The old natural levees have been in place and free from overflow waters longer than the other soils. Therefore, they have been influenced most. In general they contain less organic matter and have lost more plant nutrients by leaching and erosion. They were the first soils cleared and have had more plant food removed through cultivated crops. As a result, these soils are beginning to need complete fertilizers.

The low swags (depressional soils) have sediments washed in from the surrounding higher soils or from backwater flooding each year. These are young soils and contain enough plant nutrients, except nitrogen, to produce good crops. They contain relatively higher amounts of organic matter, but poor internal drainage and excess water limit their use.

Soils formed on the slackwater deposits usually contain higher amounts of organic matter than those formed on the natural levees. The phosphorus and potash content is medium to high, but because of leaching they are low in lime. Poor internal drainage and poor physical condition keep them from being highly productive.

Soils formed on the more recent deposits (found along Big Sand, Palusha, and Abiacha Creeks, and in isolated areas along the larger streams) have been influenced least by weathering agents. However, these sediments were washed from soils that had already been depleted of plant nutrients. They are low in all of the major plant foods and are usually low in organic matter content.

See Table 4 for chemical data and organic matter content of Leflore County soils.

6. Past Agriculture

Leflore is an important agricultural county. Cotton has always been the major crop. It has always occupied the largest acreage of cropland; corn, oats, soybeans, pasture, hay crops, and rice have occupied smaller acreages. For many years high yields were obtained without the use of commercial fertilizers. Practices for maintaining good soil tilth and high fertility levels were not considered. Row direction was used only to obtain maximum drainage and seldom ever for water conservation or prevention of erosion. These kinds of management resulted in soils having poor tilth and low crop yields.

In recent years the trend has been toward planting the best all-round agricultural land to cotton and putting the remaining land to some better adapted use such as pasture, soybeans, rice, or hay crops. Soil improving and soil conserving practices are being given more attention, and as a result crop yields have improved and a more balanced agriculture has resulted.

Table 2 indicates acreages and yields of some crops grown in Leflore County.

Table 2.
GENERAL INFORMATION ON LEFLORE COUNTY FARMS.*

	1880	1890	1900	1910	1920	1930	1940	1950	1954
Total area in Co., Acres									376,320
Total area in farms, Acres								337,610	344,127
Cropland harvested, Acres									198,574
Corn (harvested for grain) acres	10,965	16,745	29,048	32,754	42,689	36,797	60,357	30.587	15,672
bushels	144,273	371,528	633,760	604,934	602,154	838,194	1,234,505	584,737	222,761
Average: (bu. per acre	14	22.2	21.8	18.4	14.5	22.7	20.6	19.1	14.7
Cotton (harvested)									
acres	17,730	51,242	65,878	101,570	109,146	172,006	94,054	114,525	86,254
bales	11,925	31,619	39,133	38,632	40,700	109,848	89,921	85,887	72,688
Average (bales per acre)	.67	.61	.59	.38	.37	.63	.95	.75	.88
Oats (threshed for grain) acres	76	66	222	217	3	20	11,682	5,989	20,696
bushels	1,231	1,340	5,676	4,244	55	600	542,384	181,578	790,229
Average (bu. per acre)	16.2	20.3	25.5	19.5	18.3	30	46.4	30.3	38.8
Soybeans (harvested for grain) acres					96	3,247		29,175	55,558
bushels					979	2,140		490,664	418,001
Average (bu. per acre)					10.2	.65		16.8	7.3
All hay (excluding sorghum) acres	9	189	----------	232	2,053	5,519	----------	11,915	12,319
tons	12	301	----------	219	3,140	8,963	----------	15,864	12,125
Average (tons per acre)	1.3	1.5	----------	.9	1.5	1.6	----------	1.3	.9
Rice acres									5,456
bushels									336,176
Average (bu. per acre)									61.6

*U. S. Department of Commerce, Bureau of the Census (1880-1954)

Using Your Soils Map

Study Symbols

The first step in using the soil map is to examine it carefully and become familiar with the symbols used to designate certain features found on the land. These symbols are listed on page 11.

Each separate area of soil is indicated on the map with a symbol. This symbol is composed of three digits. The first digit refers to the topographic position and the kind of soil sediments from which it was formed. The second refers to internal drainage and indicates how well excess water will pass through the soil. The third gives the texture of the surface layer of soil (percent of sand, silt, and clay). These three digits are followed by a capital letter giving the slope of the land,[1] a number giving the degree of erosion,[2] and another capital letter giving the present land use.[3]

Overwash phases are indicated on the map by a plus sign. For example, 425+ represents a shallow soil, ranging in thickness from 6 to 12 inches, that is underlain by clay or silty clay.

When the soil symbol is underscored once on the map, it indicates that the soil profile rests abruptly upon a clay layer at a depth of 12 to 20 inches. When the soil symbol is underscored twice on the map, it indicates that the soil profile rests upon a clay layer at a depth of 20 to 30 inches. If a lower case "f" follows the symbol, it shows that the soil is subject to overflow from backwater flooding.

For an example, the soil symbol, 436B-2P, is analyzed as follows:

4—The soil was derived from mixed alluvium and is found on old natural levees.

3—The soil is moderately well drained internally.

6—The surface layer is a very fine sandy loam.

B—The soil has a slope of 2 to 5 percent.

2—The soil is moderately eroded.

P—The soil is being used for pasture.

The diagram on page 12 explains the numbers and letters found on the soils map. A capital T preceding a number indicates a terrace soil.

Entire Soil Profile Important

A soil profile is a vertical cross-sectional view of a soil to a depth of 40 inches or more. It includes the surface, subsoil, and parent material below the subsoil. The surface layer of two soils may be almost exactly alike, and yet the two soils may differ widely in the character of the subsoil and the material below the subsoil. Therefore, the two soils will differ widely in land use, agricultural value, and management requirements. It is important that you have a clear mental picture of the features of each soil to a depth of 40 inches or more.

The subsoil is an important part of the soil, and it is important that its characteristics be understood. It regulates (1) the rate and amount of water that can pass through the soil; (2) the ability of the soil to hold water available to plants; (3) the amount of air and other gases in the soil; (4) the depth that taproots may grow and utilize water; (5) the depth that feeder roots may go beneath the surface layer for plant food; (6) the amount of plant food leached from the soil; (7) to some extent, the amount of runoff and erosion; (8) the soil temperature which affects the developing root system and growth in general of some plants.

The material lying immediately below the subsoil is important. It may deter-

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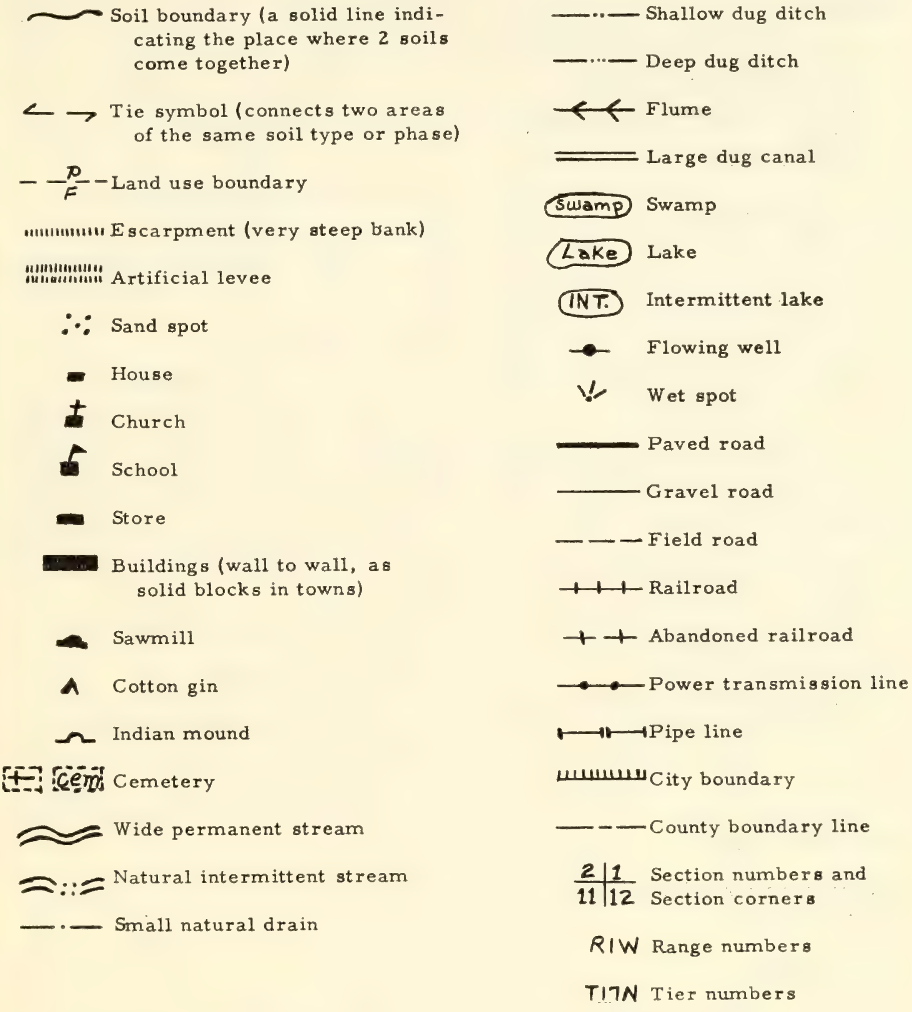
[1] The absence of the slope class symbol from the field symbol in areas outlined on the field sheets indicates nearly level areas (slope class A) with a gradient of ½ to 2 percent.

[2] The absence of an erosion class symbol in the field symbol in areas outlined on field sheets indicates areas with no apparent erosion.

[3] The absence of the land use symbol in areas outlined on the field sheets indicates land that is cultivated.

LEARN TO RECOGNIZE THESE SYMBOLS ON THE MAP


Soil boundary (a solid line indicating the place where 2 soils come together)
Tie symbol (connects two areas of the same soil type or phase)
P
F
Land use boundary
Escarpment (very steep bank)
Artificial levee
Sand spot
House
Church
School
Store
Buildings (wall to wall, as solid blocks in towns)
Sawmill
Cotton gin
Indian mound
Cem
Cemetery
Wide permanent stream
Natural intermittent stream
Small natural drain
Shallow dug ditch
Deep dug ditch
Flume
Large dug canal
Swamp
Swamp
Lake
Lake
INT.
Intermittent lake
Flowing well
Wet spot
Paved road
Gravel road
Field road
Railroad
Abandoned railroad
Power transmission line
Pipe line
City boundary
County boundary line
2 1
11 12
Section numbers and Section corners
R1W
Range numbers
T17N
Tier numbers

mine the amount of water that may be stored in the soil. It determines the height of the water table. Soils with clay layers at shallow depths usually have high water tables which may cause them to be poorly drained. Soils with sandy material underlying the subsoil have good underdrainage and are more desirable for row crop production.

Soil Types Vary

It is important to understand that a given soil type includes a range in characteristics and properties. This is a common characteristic of soils formed on alluvial deposits. Soils of Leflore County are not so uniform that every spot in an area mapped one particular soil type will be identical. Due to past management

Key to numbering and lettering system used in surveying Leflore County soils.

Position

2. Depressions (low swags)
3. Slackwater (low bottom)
4. Old natural levee formations
5. First bottoms

Internal Drainage

1. Poor
2. Poor to somewhat poor
3. Somewhat poor to moderately well- - - -
4. Moderately well to well
5. Well to somewhat excessive
6. Excessive

Surface Texture

1 Heavy clay (not used)
2. Clay
3. Silty clay
4. Silty clay loam
5. Silt loam
6. Very fine sandy loam- - -
8. Loamy fine sand (not used)
9. Sand

436B2P

Slope

A°. 0 to 1/2% level
A . 1/2 to 2% (nearly level) (No letter follows the soil type)
B . 2 to 5% (gently sloping)
C . 5 to 8% (sloping)
D . 8% plus (escarpment)

Erosion

None to slight (less than 25% of the surface soil has been lost--no number follows the soil type symbol)
2. Moderate (25 to 75% of the surface soil has been lost)

Present Land Use

F. Forest
H. Home site
Cultivated crop land (no letter follows the soil type symbol)
P. Pasture (permanent)
X. Idle Land

Overflow phase

f Subject to annual overflow (should a lower case "f" follow the end of the symbol).

Depth phases

________ Shallow (soil symbols underscored once, indicates that the profile rest abruptly upon a clay layer at a depth of 12 to 20 inches).

════════ Moderately shallow (soil symbol underscored twice, indicates that the profile rest abruptly upon a clay layer at a depth of 20 to 30 inches).

Overwash phases

+ Has had recent deposition over clay or silty clay soils.

and past land use, all soils within a given soil type will not produce the same yields. Such characteristics as slope, degree of erosion, and depth to a clay layer may affect the use and management of soils within a soil type. In some areas soil types may be found in such patterns that separation is not practical. When this condition was found a soil complex was mapped.

Some Good Uses For Your Soils Map

Determining Best Land Use

The best land use depends upon the characteristics of the soil and the desires and skill of the operator. Of the many factors to be considered in determining best land use, the physical characteristics of the soil are among the most important. If the soils are low in plant nutrients these can easily be added, but the physical properties are very difficult to improve. Because of the physical characteristics of a given soil, such as poor drainage, droughtiness, or poor tilth some plants may not be well adapted, resulting in low yields, while another plant may be well adapted and return high yields. As an example, corn planted on Alligator clay soils usually returns low yields, but rice yields well on this soil.

In Leflore County the physical characteristics have not always been given enough attention. Poor plant growth, inadequate crop yields, deteriorating soil structure, erosion, and a gradually diminishing supply of plant nutrients and organic matter in the soils have resulted.

High crop yields year after year are the results of good management practices fitted to specific kinds of soils. Planting crops on soils to which they are adapted is the basic step upon which other applied practices depend. No cultivated crop will be expected to produce its highest yields if it is planted on land to which it is not adapted.

Check the section on land capability groups and see what crops are adapted to your soils. Turn to the index and see the average yields that can reasonably be expected for some locally grown crops when they are planted on soils to which they are adapted and when other good management practices are applied.

Study the characteristics of your soils, given in the section on soil series and types of Leflore County, and you will be able to select those crops which are best adapted to your soils.

Guide to Drainage

On some of the soils of Leflore County natural surface drainage is adequate. On others artificial drainage is essential in obtaining good land use. Open ditches are best fitted to the soil and slope and will give more satisfactory drainage than underground tile drains.

The soil map can be a guide for locating a system of natural surface drainage. The long and usually narrow depressional areas (the soil type numbers 212, 220 and 235) are a part of the natural drainage pattern of each farm. These soils usually produce low yields and should be used primarily for the location of drainage ditches and secondarily for the production of some adapted crop. Occasionally it is necessary to cut ditches across ridges to drain isolated low areas. This should be avoided as much as possible because the absence of cross ditches results in longer rows which are essential to mechanized farming.

The size of the watershed area and the soil types included within the area will determine the type and size of ditches needed. Surface runoff from sandy soils is much less than from clay soils; therefore, the clay soil areas will need more and bigger ditches for adequate drainage.

Basis for Field Layout and Row Direction

Field layout should be arranged so that soil types that differ in their ability to produce the same crops and that require different management practices will be separated. Fertilizer applications and other management practices that are best for each soil type can then be planned.

Roads and turnrows located on soil boundaries tend to divide land into fields which include soil types that respond to the same management practices. Roads that cross soil boundaries, rather than follow them, may divide fields into smaller units that will not respond to the same management practices and that are undesirable for mechanized farming. Roads that cross soil boundaries on sloping land (ridge land) tend to cause excessive runoff, increase erosion hazards, and cause loss of soil moisture.

The boundaries of soils on B (2-5%) and C (5-8%) slopes, as well as escarpments and stream banks, are good locations for roads.

Row direction is an integral part of any good drainage system. Soil type, slope of the land, and method of tillage are factors that will determine row direction. On poorly drained soils the row direction should be such that each row will carry its excess water to an outlet. However, this should not be done to the extent that erosion occurs. The row direction for soils on level slopes should provide for the best possible runoff. The moderately well, well, and excessively drained soils (soil type numbers whose middle digit is 3, 4, 5, or 6) should have rows running on the contour in order to conserve moisture and prevent accelerated erosion. Generally, this means the rows should parallel the natural low swags, streams, bayous, and ridges. In laying out a system of row direction on the contour, consideration should be given to the problem of removing excess water during periods of prolonged wet spells, as well as to the conservation of moisture.

The above suggestions usually make it possible to lay out permanent fields with larger areas and longer rows. The longer rows over uniform soils tend to make mechanized farming more efficient.

Guide in Fertilization

Satisfactory yields cannot be produced on soils that are deficient in plant nutrients. It has long been recognized that nitrogen is the plant food most lacking in Leflore County soils.

Most of the sediments from which Leflore County soils were formed contained fairly high amounts of most of the mineral elements, except nitrogen. The removal of crops from the land year after year and the dissolving-and-leaching action of rain water finally cause all soils in a humid climate to become acid and deficient in plant nutrients. Indications are that some soils in the county have become deficient in some of the nutrient elements, or they are approaching a deficiency in these elements. Following is a discussion of the major plant food elements:

Nitrogen—An adequate amount of nitrogen is essential to obtain vigorous crop growth and maximum yields. It may be supplied as commercial nitrogen, or it can be supplied as organic nitrogen. Due to the high temperature and moisture supply in Leflore County, it is difficult to increase the organic matter content of the soils or maintain it at high levels.

Pasture sods are probably the fastest and best means of increasing the organic matter in soils. Crop residues plowed under, green manure crops, and manure provide sources of organic matter that will help to maintain the organic matter content.

Lime—All soils in Leflore County are acid. Cotton, which is the most important cash crop, is an acid tolerant plant; however, it will not produce maximum high yields on strongly acid soils. Clovers and other legumes grow best on soils that are slightly acid, neutral, or slightly alkaline. If tests show that the soil is acid, this unfavorable condition is easily corrected by applying ground limestone. The amount of lime necessary to bring the reaction up to the desired level depends primarily on three factors: (1) pH and (2) texture of the top soil and (3) organic matter. Soils with high clay content in the top soil will require much larger applications of lime to bring them to the desired pH level than sandy soils with the same pH.

Phosphate and Potash—Past experimental work with phosphate and potash fertilizers on most soils in Leflore County has shown little need for these minerals. However, there have been isolated areas that have given some response to their application. Chemical analyses of soils sampled in Leflore County and the experience of some farmers indicate a deficiency of phosphate and potash in some soils. Such soil types as 425, 426, 435, 436, 445, 446, 456, 466, 524, 525, T526, 535, and T536 are likely to show a lack of these elements. Because of past cropping history there are different levels of these elements. Therefore, it is desirable to have soil test made before either phosphate or potash fertilizers are applied. Soil test and experience show that Types 212, 220, 235, 236, 312, 314, 423, and 424 contain relatively high levels of phosphate and potash. Little or no increase in yield should be expected from the application of either phosphate or potash to these soils.

Reliable Soil Analysis—Reliable soil analysis is a very good indicator of soil fertility. Because of the wide differences in the levels of plant nutrients in the soils of Leflore County, it is very important to have an inventory of the plant food available before additional fertilizers are added to the soils. Collection of representative soil samples is one of the most important steps in soil testing. Because of the different levels of plant food in unlike soils in Leflore County, samples collected from unlike soils and mixed together will not give a true analysis of either of the soils represented.

For example, soil type 312 (Alligator clay) is medium to high in potash (319 to 650 pounds of exchangeable potassium), but soil type 425 (Forestdale silt loam is low to medium (137 to 280 pounds of exchangeable potassium). If both of these soils are found in the same field and equal amounts of soil from each soil type is included in one sample, the results will not represent a true analysis of either soil. Therefore, the results will be of little value in determining whether the field does or does not need additional fertilizer. For this reason, samples from soils that are unlike should not be mixed together. If the soil map is used as a guide in sampling soils, this error can be eliminate. See Basis for Field Layout and Row Arrangement, page 14.

Fertilizer is only one of the means by which productivity of land can be increased, but it is a highly important one. It will require more and more consideration as our soils grow older agriculturally. According to the United States Bureau of the Census, Mississippi farmers spent $40,773,991 for commercial fertilizer in 1954. Leflore County farmers used 15,728 tons of commercial fertilizer in 1954 at a cost of almost one million dollars. An inventory of the plant food available in the soil serves as a basis for using the correct kind and amount of fertilizer on each field. When the correct kind and amount of fertilizer needed on a particular field for a particular crop is known, a wise use of capital is insured.

The Soil Testing Laboratory at State College is staffed with trained soil scientists who are capable of giving valuable service to farmers regarding their fertilizer needs. Talk with your County Agent regarding this service, or better still visit your Soil Testing Laboratory at State College and let the staff explain the procedures used in the Laboratory, and the services they are able to render to the farmers of Mississippi. Be sure and have your soils tested every three or four years and take the guess-work out of fertilization.

Fertilizer recommendations for cotton, corn, soybeans, sorghum for silage grain or syrup, sugarcane, and the pasture recommendations in Table 3 were based on the Mississippi Experiment Station and Extension Service recommendations issued in 1956.

Cotton: Apply 90 to 100 pounds of nitrogen prior to planting time on the silt loam and sandy loam soils (soil types ending in 5 or 6) and 100 pounds prior to planting time on clay, silty clay, and silty clay loam soils (soil types ending in 2, 3, or 4). Sandy loam soils with very good to excessive internal drainage (soil types 456, 466, and 467 in this county) should have 45 to 50 pounds of nitrogen prior to planting and 45 to 50 pounds as a side dressing.

If a good growth of green manure is turned under, little if any additional nitrogen is needed. If poor stands or a poor growth prevails, commercial nitrogen should be applied accordingly.

If nitrogen is applied as a side dressing, make applications immediately after the first chopping is completed.

Apply anhydrous ammonia as deep as conditions will permit. It must be sealed in the soil to prevent loss. Apply solid materials 6 to 8 inches deep.

Apply phosphate and potash fertilizers to meet needs indicated by soil test.

Corn: Apply 120 pounds of nitrogen at planting time or in split applications.

Place nitrogen as deep as practical with available equipment. (A depth of 6 inches is desirable).

Leave approximately 12,000 corn plants per acre or one plant every 12-14 inches apart.

Soybeans: No fertilizer recommended.

Sorghum: (for silage, grain, or syrup) Thirty to sixty pounds of nitrogen at planting, placed approximately six inches deep under the drill.

Sugarcane: Thirty-five to sixty-five pounds of nitrogen at planting, placed approximately six inches deep under the drill.

Guide to Irrigation

Droughts of sufficient duration to reduce yields of summer pastures and row crops occur frequently in Leflore County. Perennial pasture crops suffer severely most years during mid and late summer from high temperature and lack of moisture. From experimental results and the experience of some farmers, yields of most all commonly grown row crops and pasture crops can be increased with irrigation during most years.

The best irrigated soils, for most crops, are deep and moderately permeable to water, both when wet and dry. They have gentle uniform slopes and lie high enough above streams and other outlets so that drainage is good enough to remove surplus water in case heavy rains follow irrigation. The water table should be several feet below the surface, and the soil should be sufficiently permeable for water to move downward at a moderately rapid rate.

In addition to the best soils many other soils are suitable for irrigation but may be lower in value for this purpose. These may be somewhat shallower than the ideal, the textures may be too clayey or too sandy for the best results, or the slope may be such that they will have to be leveled or sprinkler irrigation used, but they may still be within the range of soils that can be irrigated. The best soils for rice irrigation are clay soils that hold water because water has to cover the surface of the soil while rice is growing.

The type of irrigation, amount of water per application, and number of applications required, are directly dependent upon the type of soil and the crop. Most soils of Leflore County, with the exception of those on steep slopes, may be irrigated successfully. However, fine textured soils such as Alligator, Dowling, and Forestdale clay, silty clay, and silty clay loams, are not well suited to sprinkler irrigation.

Irrigation should increase farm income enough to cover the cost of buying, main-

Table 3. Delta Pasture and Grain Crops Recommendations

Pasture Crop	Recommended varieties	Rate of seeding per acre	Fertilizer	Time of planting
Alfalfa	Buffalo Kansas Common Okla. Common	10-20 lbs.	Test soil for lime, phosphate and potash	Oct. 1-15
Bermuda grass	Coastal Common	Sprig Coastal 5 lbs. seed Common	60 lbs. nitrogen Coastal (irrigated) 180 lbs. nitrogen (4 applications)	Mar. 1-May 1
Dallis grass	Imported or Domestic	10 lbs. live seed	30 lbs. nitrogen after germination 60-30 lbs. nitrogen annually thereafter	Oct. 1-Nov.1
Tall Fescue and White Clover		5-10 lbs. Fescue 1-2 lbs. Clover	30 lbs. of nitrogen at planting; 60 lbs. nitrogen for winter grazing	Oct. 1-Nov.1 Feb.-May 1
White and Red Clover		2 to 4 lbs. 10 to 15 lbs.	Test soil for lime, phosphate, and potash	Oct. 1-Nov. 1
Crimson Clover	Hard seeded for volunteer crop	12 to 15 lbs.	Test soil for lime, phosphate, and potash	Oct. 1-Nov. 1
Dallis grass-Lespedeza	Korean or Climax	20-25 lbs. lespedeza; 10 lbs. Dallis grass	30 lbs. nitrogen after germination 60-30 lbs. nitrogen annually thereafter	Dallis grass Oct. 1-Nov. 1 Lespedeza Feb. 15-Mar. 15
Tall Fescue		10 lbs.	60 lbs. nitrogen in Sept. 60 lbs. nitrogen in Feb.	Oct. 1-Nov. 1
Lespedeza	Korean or Climax	20 to 25 lbs. seed in small grains	None recommended	Feb. 15-Mar. 25
Sudan grass	Tift Sweet	6-8 lbs. in 38 to 48 inch rows	60 lbs. nitrogen	June 1-20
Oats (for grain)	Nortex 107, Delta Red 88 Fulgrain, Delair, Arlington	3 bu. 2½ bu. for grain	45 to 60 lbs. of nitrogen March 1 to March 15	Mid Oct.
Wheat (for grain)	Chancellor Atlas 66, Coker	1¼ bu.	Same as oats	Same as oats
Oats, Rye, Wheat or Barley for Forage		3 bu. oats 1½ bu. wheat	60 lbs. of nitrogen in Sept.	Early Sept.

Table 4. Quick Test Data for Leflore County

Soils Sampled	I[1]		II[2]		III[3]		IV[4]		V[5]	
No. of sample locations	55		42		38		61		30	
	Sur. %	Sub. %	Sur. %	Sub. %	Sur. %	Sub. %	Sur. %	Sub. %	Sur. %	Sub. %
ORGANIC MATTER										
Very low (0 to 1 percent)	0	49	0	76	21	99	36	75	50	99
Low (1.1 to 2 percent)	23	51	67	24	63	1	64	25	50	1
Medium (2.1 to 3.25 percent)	62	0	33	0	16	0	0	0	0	0
High (3.25 to 4 percent)	15	0	0	0	0	0	0	0	0	0
Soil Reaction (pH)										
Neutral[6]	5	0	0	0	0	0	0	0	0	0
Slightly acid	26	3	28	0	42	0	34	6	50	0
Medium acid	41	27	57	36	21	31	34	42	40	90
Strongly acid	28	58	15	63	37	69	27	32	10	10
Very strongly acid	0	12	0	1	0	0	0	20	0	0
PHOSPHATE (Lbs. Equiv. P_2O_5 per acre-surface only)										
Low (0 to 76 lbs. per acre)		0	0			0		0		0
Moderately low (76 to 105 lbs per acre)		5	0			19		5		0
Medium (106 to 161 lbs. per acre)		29	23			14		39		30
High 162 to 251 lbs. per acre)		35	42			47		34		60
Very high (252 to 447 lbs. per acre)		31	35			20		17		10
POTASH (Exchangeable K_2O per acre)										
Low (0 to 175 lbs. per acre)		0	0			36		18		20
Moderately low (176 to 235 lbs. per acre)		0	4			21		32		40
Medium (236 to 429 lbs. per acre)		27	92			43		47		40
High (430 to 527 lbs. per acre)		33	4			0		3		0
Very high (527 to 650 lbs. per acre)		40	0			0		0		0

Data by: Soil Testing Laboratory, Agronomy Division, Mississippi Extension Service and Mississippi Experiment Station Cooperating, State College, Mississippi.

[1] These samples were collected from the following soils: 312.

[2] These samples were collected from the following soils. 314 and 424.

[3] These samples were collected from the following soils: 425 and 426.

[4] These samples were collected from the following soils. 435, 436, 445, 446, 456, and 466.

[5] These samples were collected from the following soils: 525, 535, T525, and T536.

[6] Strict neutrality is PH u.0, but in field work those soils between pH 6.6 and 7.3 are called neutral.

taining, and operating the irrigation system and leave a reasonable return on the owner's investment. To insure such a return on your investment, the following conditions should be met: (1) irrigate land that is capable of returning high yields because water alone will not insure high yields; (2) maintain a high fertility; (3) be sure you have an adequate water supply; (4) irrigate crops that have a reasonably high dollar value; and (5) be sure your system is designated to fit the particular area to be irrigated. If the best results and highest yields are to be expected from irrigation, other production practices need to be maintained at high levels. Irrigation, especially on cotton, increases favorable environment for insects, and measures for control have to be increased or the benefits from irrigation will be lost. Higher yields demand more plant food, and fertilizer rates have to be increased to meet the demand. If these and other management problems are met, yields of most crops can be increased with irrigation.

Land Leveling

Many fields are too sloping or the slopes are too uneven for furrow or flood irrigation. Some land has been leveled or graded so that furrow or flood irrigation can be practiced. The long-time results of this operation on crop yields have not been determined. However, studies made on fields that have been graded indicate that over-all yields (total yields in fields) are not influenced adversely by this operation for most soils of Leflore County.

It should be pointed out that the cutting of soil from some areas and filling of other areas will change some of the physical properties. On some of the Forestdale, Dundee, Dubbs, and Bosket soils (soil type numbers 425, 426, 434, 435, 436, 445, 446, and 456) the surface texture will be changed from silt loam or very fine sandy loam to a clay, silty clay, or silty clay loam if as much as 6 inches of the top soil is removed. This means that the soil is not as easily tilled, the intake rate is reduced, and proper adjustment will have to be made in rates of aplication.

On the other hand, surface textures of Alligator or Dowling soils (soil type numbers 312, 220, and 212) may be improved by filling. Although surface textures are improved, these soils will still have poor internal drainage.

Soils that have widely varying degrees of internal drainage, vary widely in water-holding capacity, or vary materially in rate of intake should not be included in the same run. Runs over uniform soils and slopes prevent flooding of some areas before other areas of the field are wetted.

The feasibility of land leveling will be determined by the soil type, slope of the land, and the crop to be grown. Before operations begin, consult a trained agricultural engineer. Usually such an engineer who is well informed as to the problems involved will save you money. Learn something of the cost of the operation and the expected profits to be returned.

Pans

Pans (plow soles) have formed in some of the better drained soils of Leflore County. They usually form immediately beneath the plow layer. These plow soles are compact, dense layers that are very hard when dry. They range from 2 to 6 inches in thickness and slow the downward movement of water, roots, and air into the soil. If plant roots are restricted to the 5 to 7 inch plow layer they are not able to utilize the water and fertility of the subsoil.

On experimental plot tests at the Delta Branch Experiment Station, it was found that shattering of the compacted layers reduced grass and weed damage and increased water intake, root development, and crop yields. On a Dubbs fine sandy loam soil cotton yields were increased from 900 pounds of seed cotton per acre on plots that had no deep tillage to 2,241 pounds of seed cotton per acre on plots that had been broken to a depth of 16 inches with chisels. Similar response to deep tillage was obtained on similar soils to the Dubbs fine sandy loam where plowsoles had formed in the soils. Deep tillage practices are expensive and have proved to be of little value unless a plowsole is present. Because of this, deep tillage of soils that do not have plow-soles may be waste of capital and labor.

Pointing Out Specific Problems

Each soil condition has problems that may or may not be general in all of your soils. All may have the same surface texture; but the internal drainage could vary from poor to excellent. This variability can affect crop adaptation. On the other hand, the internal drainage may be the same on all of your soils, but surface textures may vary widely. These variations can affect the choice of crops and methods of tillage.

Slopes of the different soils may cause

problems in row directions, field boundaries, and surface drainage. The stronger slopes present erosion problems, whereas the almost flat slopes present problems of adequate drainage.

Many fields in Leflore County have two or more soils with widely varying characteristics that require different types of crops and management. When the area of one soil is very small, it is often necessary to farm it the same as the surrounding type or types. Otherwise, each soil type can be managed separately and put to its best land use.

Soil Management Groups of Leflore County; Their Use and Treatment

Soils are complex, and there is much yet to be learned about their use and management. We are now in the midst of a technical revolution in agriculture. With the rapid changes taking place in the agricultural arts, different uses of the soils may develop and different management problems may arise that we cannot foresee. To better meet the rapid changes taking place, study your soils and learn something of their characteristics and how these characteristics affect crop production and management problems. Learn something of the requirements of good soil management and good farm planning. Study the characteristics of each kind of soil mapped in Leflore County, beginning on page 35 under "Soil

Table 5. Outline of the Land Capability Classification

Major land use suitability (Broad grouping of limitations)	Land capability class (Degree of limitations)	Land capability subclass* (Grouping of land capability units according to kinds of limitations)
Suited for cultivation	I. Few limitations. Wide latitude for each use. Very good land from every standpoint (green on map)	
	II. Moderate limitations or risks of damage. Good land from all-around standpoint (Yellow on map)	IIe. Limited by hazard of water erosion; gently sloping land. IIw. Limited by excess water; drainage needed for cultivation. IIs. Limited by special soil condition.
	III. Severe limitations or risk of damage. Regular cultivation possible if limitations are observed. (Red on map)	IIIe. Limited by hazard of water erosion. IIIw. Limited by excess water; drainage needed for cultivation. IIIs. Limited by special soil condition.
	IV.** Very severe limitations. Suited for occasional cultivation or for some kind of limited cultivation. (Blue on map)	
Not suited for cultivation	VII** Not suited for cultivation. Use limited to grazing or forest. (Brown on map)	VIIs Limited by excessive internal drainage.

*The land capability maps of Leflore County, as they are now being colored, do not differentiate between the variations in the land capability subclasses. As an example: Subclasses IIIe, IIIw, and IIIs are shown on the maps in the same color.

**Only one subclass occurs in these land-capability classes.

Series and Soil Types of Leflore County".

The soils of Leflore County have been grouped into fourteen separate "Use and Treatment" groups. The soils within each group have similar profiles, drainage, relief, slope, and degree of erosion. The same crops are adapted to each, and they respond to like treatment.

GROUP 1. (Land Capability Class I)

Description of Land

General: Somewhat poorly to somewhat excessively drained, none to slightly eroded, loamy soils on nearly level relief (½ to 2 percent slopes).

Surfaces: The surfaces are grayish-brown to pale-brown silt loams and very fine sandy loams, varying from 5 to 8 inches thick. The soils work easily but are subject to crusting and packing by rain when bare.

Subsoils: The subsoils are brown, slightly mottled to mottle-free and range in texture from silty clays to silt loams. They allow good movement of water and air through them and permit fairly deep root penetrations. The available moisture capacity is good to low.

Position: They occur in small to fairly large areas on the highest altitudes of the old natural levee formations.

Group Consists of: Land Capability Class I—435, 436, 445, 446, 456, 466, and 835.

Use and Treatment

Surface drainage: Row direction should usually follow the ridges and depressions, generally on the contour, to conserve moisture, soil, and fertility. Little, if any, artificial drainage is needed.

Subsoiling and other tillage practices: Compacted areas (plow-soles) occur occasionally in this group of soils. These plow-soles should be broken during dry weather in the later fall months.

Fall plowing is a common practice. It is of little value, other than possibly helping to control insects. Erosion hazards caused by this practice can be very costly in terms of valuable topsoil and plant nutrients lost during the winter months of normally high rainfall.

Adapted crops: The best use for these soils is for the production of cotton. They are good soils for winter and early truck crops, but only a small number of acres are used for this purpose. The characteristics of these soils are such that most all crops commonly grown in Leflore County are adapted. They are well suited to timber and wildlife, but they are too valuable as cropland to be used for this purpose.

Rotations: When used for continuous row crops, such as cotton, the growing of winter legumes annually helps maintain good tilth and fertility levels. These are the most productive and best all-round agricultural soils of the county, and with good management, may be expected to produce high yields continously.

Fertility: The soils are low in organic matter. They respond well to additions of organic matter. They are usually slightly to medium acid in reaction, but some may be strongly acid. Soil test results indicate that the available phosphate level is medium to high and the available potash level is low to medium.

Irrigation: These loamy soils give good response to irrigation of most crops. The mild slope, moderately rapid to rapid infiltration rate, the potential high yielding ability, and their favorable position in relation to streams or other outlets into which excess water can be drained are factors that make the soils favorable for irrigation.

Land Leveling: Unpublished data indicate that over-all yields are not affected by land leveling on this group of soils. However, some soil properties are changed. Cuts of 0.2 feet or less will have little, if any, influence on the soil properties. Cuts of more than 0.4 feet will have an adverse effect on the texture, structure, consistency, organic matter content, infiltration rate, seedbed preparation, and the ease with which the soils are tilled.

GROUP 2. (Land Capability Class II)

Description of Land

General: Somewhat poorly to moderately well drained, silt loams and very sandy loam soils on nearly level to gently sloping relief. There is no erosion. These soils are subject to periodic overflows, and an accumulation of new sediments may be left when the floodwaters move off.

Surfaces: The surfaces are yellowish-brown or pale-brown silt loams or very fine sandy loams, ranging from 6 to 12 inches in thickness. They work easily, but rain causes them to crust when bare.

Subsoils: The subsoils are yellowish-brown to brownish-yellow silt loams. The upper part of the subsoil usually contains a few mottles and brown concretions. The water table is high, the available moisture holding capacity is good, root penetration is deep, and they allow good movement of water and air through them.

Position: They occur in small to fairly large areas on the recent alluvial sediments, and are found predominately in the eastern section of the county.

Group consists of: 535, T535, T536, and T536B.

Use and Treatment

Surface drainage: Row direction should be such that each row will carry its excess water to a proper outlet. Artificial drainage, including protection from floodwaters, is needed. A system of V-and W-type ditches to drain the low areas of the fields, and a system of larger (dragline) ditches is usually needed for adequated drainage.

Subsoiling and other tillage practices: Compacted areas (plow-soles) may form in these soils. However, none have been found within this group during the progress of the soil survey. Deep breaking once during the year will probably prevent the formation of these so-called pans. Seedbed preparation is best done in the spring.

Adapted crops: Cotton is well adapted to this group of soils, and this is the best use for this land. Their high water table, their ability to supply water to plants, and their physical properties make the soils some of the best corn land in Leflore County. Other crop plants such as small grains, soybeans, winter legumes and most of the pasture grasses and legumes commonly grown in Leflore County are also adapted to the soils. The soils are suited to timber and wildlife, but only a very small percent is used for this purpose.

Rotations: These soils may be planted to row crops continuously. When planted to row crops, such as cotton, continuously the growing of winter legumes annually will help maintain good tilth and fertility. Suggested rotations are three years of pasture crops, and six years of row crops, or two years of small grain followed by lespedeza and two years of row crops.

Fertility: The soil reaction is medium to slightly acid. The organic matter content and nitrogen level is low, and this group of soils responds well to additions of both organic matter and nitrogen. Soil test results indicate that the available phosphate level is medium to high and available potash level is low to medium.

Irrigation: Because of the high water table, this group of soils may not give as good results to irrigation as do soils in Group I1. The high water table helps to make water available to plants further into the dry season, and for this reason the need for irrigation may be delayed to a later date. However, irrigation should pay dividends on most crops. The mild slope, moderately rapid infiltration rate, depth of the soil, and the potentially high yielding ability of the soils are factors that favor irrigation. Care should be taken to insure drainage of excess water to prevent depressed plant growth if heavy rains follow irrigation.

Land Leveling: Unless very deep cuts are made, the soil properties are not changed by land leveling. The slopes are usually smooth, and only shallow cuts are needed to bring the slope to the desired grade.

GROUP 3. (Land Capability Classes IIe1, IIe2, IIs1, and IVe3)

Description of Land

General: These soils are somewhat poorly to excessively drained, slight to moderately eroded, loamy soils on gently sloping 2 to 5% slopes, sloping 5 to 8% slopes, and strongly sloping 5% plus slopes.

Surfaces: The surfaces are grayish-brown to pale-brown silt loams, very fine and sandy loams, and sand loams. They range from 4 to 6 inches in thickness, they work easily, but rain will cause them to crust and erode easily when bare.

Subsoils: The brown, slightly mottled to mottle free subsoils range in texture from silty clays to sandy loams. The available moisture capacity is good to very low, they allow good movement of water and air through them, and root penetration is fairly deep.

Position: They occur in fairly long narrow bands adjacent to present or former stream channels. They are found on some stronger slopes of the old natural levees.

The group consists of:

Land capability class IIIe1,-435B2, 436B3, and 446B2.

Land capability class IIIe2-456 and 456B2.

Land capability class IIe1,-435B, 435B2, 436B, 436B2, 445B, 445B2, 446B, 446B2, 835B, 435C, 436C, and 446C.

Land capability class IIe2-456B and 456B2.

Land capability class IIs1-4467B and 466-B.

Land capability class IIIs1-460C2.

Land capability class IVe1-460D2.

Use and Treatment

Surface drainage: Row directions should follow the contour to prevent further erosion and to conserve moisture and fertility. No artificial drainage is needed.

Subsoiling and other tillage practices: Compacted areas (plow-soles) occur in this group of soils. Where these occur, plant roots and available moisture are restricted to the plow layer. They should be broken during the dry late fall months. To reduce erosion hazards during the winter months, all seedbed preparation for row crops should be done in spring.

Adapted crops: Cotton is well adapted to the soils but, because of the slope the soils should not be used as intensely for cotton production as the soils of group one and two. Winter and early spring truck crops are well adapted to the soils, but care should be taken to prevent erosion during the months of normally high rainfall. Winter grazing crops are adapted, and this is an excellent use for the soils as the good surface drainage tends to reduce the bogging of cattle during long wet periods.

Rotations: If these soils are used for continuous row crop production, such as cotton, the growing of winter legumes will help to maintain good tilth and fertility. If the area is large enough to separate from the rest of the field, a suggested rotation is three years of pasture or other sod crops, and three years of row crops. Another suggested rotation is two years of small grains and vetch, and two years of row crops.

Fertility: The soils respond well to additions of nitrogen and organic matter. They are usually medium to slightly acid in reaction, but some may be strongly acid. Soil test results indicate that the available phosphate level is high to medium and the available potash level is low to medium.

Irrigation: This group of soils has the same properties as Group I, except slopes, and they will give the same response to irrigation as that group. The slope is too steep for furrow or border irrigation systems to give the best results, but sprinkler systems properly designed for a particular field are successful.

Land leveling: Because of the stronger slopes, these soils are not well suited to land leveling. Deep cuts are usually needed to bring the slope to the desired grade. These deep cuts may expose sand.

GROUP 4. (Land Capability Classes IIs6, IIe4, and IIIe3)

Description of Land

General: Somewhat poorly to moderately well drained mixed soils on nearly level (½ to 2 percent slopes), gently sloping (2 to 5 percent slopes) and sloping (5 to 8 percent slopes). The erosion hazard is none to slight.

Surfaces: The surfaces are grayish-brown silty clay loams, 4 to 6 inches thick. They are sticky and plastic when wet, hard when dry, and they are somewhat difficult to work.

Subsoils: The subsoils are mottled brown silty clays. They allow fairly good movement of water and air through the soil, the available moisture capacity is good and root penetration into the subsoils are fairly deep.

Position: The soils are found in small areas on the old natural levee formations.

Group consists of: Land capability class IIe6-434.

Land capability class IIe4-434B, 434B2.

Land capability class IIIe4-434C, 434C2.

Use and Treatment

Surface drainage: In general row direction should follow the ridges and depressions. Little, if any, artificial surface drainage is needed.

Subsoiling and other tillage practices: Compacted areas (plow-sloles) may form; however, they do not form as frequently in this group of soils as they do in group I. If compacted areas do form, they should be broken during dry weather in the late fall months.

Crop residue should be cut in the fall, winter legumes should be allowed to grow as late as possible in the spring, and all seedbed preparations for row crops should be done in the spring.

Adapted crops: These are good soils for the production of cotton, and, with the exception of the soils on the steeper slopes, can be planted to cotton continuously. Soybeans and small grains are well adapted to the soils and return good yields, and most other crops commonly grown, including pasture grasses and legumes, can be produced successfully on these soils.

Rotations. They will produce good yields continuously if winter legumes are grown annually. However, for highest yields and best soil improvement, summer legumes or grass and legume sods should be grown two years out of six. Another suggested rotation is two years of small grain and three years of row crops. The sloping areas should have more intense rotation practices to reduce soil loss by erosion.

Fertility: The soil reaction ranges from strong to medium acid. Soil test results indicate that the available phosphate level is medium to high and the available potash level is low to medium. They respond well to additions of nitrogen and organic matter.

Irrigation: Because of the high clay content, the slow to moderately slow infiltration rates and high water holding capacity, these soils are not as well suited to irrigation as the loamy soil groups. They should give a fair response to irrigation but, because of the necessity for slower rates of application, cost will be higher. Sprinkler systems are best suited to the soils on gentle and sloping relief.

Land leveling: Soil properties, except organic matter, should not be changed materially by land leveling. Usually the desired grade can be had with the moving of a minimum amount of soil on the nearly level slopes. Because of the slope, the deep cuts necessary to acquire the desired grade, and the high dollar cost, it is not recommended that soils on the gently sloping and sloping relief be leveled.

GROUP 5. (Land Capability Class IIs3)

Description of Land

General: These are nearly level (½ to 2 percent slopes) and gently sloping (2 to 5 percent slopes), none to moderately eroded, poorly to somewhat poorly drained, moderately deep loamy soils.

Surfaces: They have light grayish-brown to light brownish-gray silt loams and very fine sandy loam surfaces, ranging from 5 to 7 inches in thickness. They work fairly easily, but rain will cause them to crust and erode when bare.

Subsoil: The subsoils are highly mottled gray to light brownish-gray clay, silty clay, or silty clay loam. Because of the high clay content, the movement of water and air through the soil is slow. The moisture capacity is good, but root penetrations into the subsoils are shallow.

Position: They occur in small to fairly large areas on the lower elevations of the old natural levee formations.

Group consists of: 425+, 425, 426, 425B, 425B2, 426B.

Use and Treatment

Surface Drainage: On the soil types on the nearly level slopes (soil types 425+, 425, and 426), row direction should be such that each row will carry its water to a proper outlet. The fall for each row should be small enough to prevent erosion. A system of W-and v-type ditches located in the low areas is usually needed.

Soils on the steeper slopes (soil types 425B, 425B2, and 426B) need row direction on the contour to prevent erosion. No improved surface drainage is needed.

Subsoiling and other tillage practices: Compacted areas (plow-soles) are found occasionally. Where compacted areas occur, the penetration of plant roots into the subsoil, the movement of water and air, and available moisture supply are restricted. When found, they should be broken during dry weather in the late fall.

Fall plowing makes the erosion hazard great. Deep seedbed preparation and frequent cultivation will improve water infiltration and aeration. No tillage practice should be carried out when soils are wet.

Adapted crops: These are good soils for the production of cotton and, with the exception of the soils on the steeper slopes, can be planted to cotton continuously. The crusting of the silty textured surface soil is somewhat of a hazard to obtaining good stands, but this hazard can be partly eliminated by planting on firm seedbeds. Soybeans are adapted to the soils, and they are a good crop to use in rotation with cotton. The production of small grains, corn, and pasture are other good uses for the soils.

Rotations: Annual non-legume row crops should be followed by winter legumes. Suggested rotations are: Three years of pasture or sod crops, and two years of row crops; two years of soybeans, one year oats and vetch, and two years of row crops.

Fertility: The soil reaction is strongly to medium acid. Soil test results indicate that the available phosphate levels are medium to high and the available potash levels are low to medium. Organic matter contents are low, and good response is shown to additions of nitrogen and organic matter.

Irrigation: Soils on the steeper slopes (B slopes) are not suited to furrow or border irrigation. The slow to moderately slow infiltration rate may cause the soils to stay wet, causing depressed plant growth if rains follow irrigation. However, if adequate surface drainage is provided so that water does not pond, this hazard can be partly eliminated, and fair response to irrigation can be obtained. The soils are suited to the irrigation of rice.

Land leveling: Indications are that land leveling has depressed yields on this particular group of soils. The removal of the surface four inches of soil causes a marked change in texture, structure, consistence, permeability, root penetrations, and the ease with which seedbeds are prepared and the soils cultivated. The change in soil properties probably accounts for the reduced yields.

GROUP 6. (Land Capability Class IIs3)

Description of Land

General: Somewhat poorly to poorly drained, grayish-brown to light yellowish-brown loamy soils on nearly level (½ to 2 percent slopes) and gently sloping (2 to 5 percent slopes) relief.

Surfaces: The surfaces are grayish-brown to yellowish-brown silt loams and very fine sandy loams, ranging from 6 to 10 inches in thickness. The high percent of silt present causes these soils to crust and pack easily.

Subsoils: The mottled light gray to grayish-brown silt loam subsoils cause water and air to move slowly through them. The available moisture is good, the water table is high; and the high water table, to a large degree, determines the depths to which roots will penetrate.

Position: They occur in small to fairly large areas on recently deposited sediments, predominately in the eastern section of the county.

Group consists of: 525, 525B, T525, T525B, T526, T526B, and 500.

Use and Treatment

Surface drainage: The runoff from soils on the nearly level slopes (soils types 525, T525, T526, and 500) is slow, and artificial drainage, including protection from overflow, is needed. Row direction should be such that each row will carry its excess water to a properly constructed outlet. The low areas can be drained with v-and-w-type ditches, but primary drainage in the form of open (dragline) ditches is needed to remove excess runoff.

Row direction on the stronger slopes (Soil types 525B, T525B, and T526B) should be on the contour. No improvised drainage is needed on this group.

Subsoiling and other tillage practices: Compacted areas (plow-soles) will form; however, only very small areas with "plow-soles" were found during the progress of the soil survey. Deep breaking once each year will probably prevent the formation of these compacted layers.

Seedbed preparation is best done in the spring. The soils need deep preparation and frequent cultivation to improve aeration.

Adapted crops: Although the tendency of the soils to overflow is somewhat of a hazard to crop production, these soils produce good yields of cotton, and it is recommended that they be used for cotton production. They are excellent soils for the production of corn, and soybeans, small grains, hay and pasture crops are well adapted to the soils. All of the soils included within the Falaya, Ina, and Collins soils complex (soils whose mapping symbol is 500) are still covered with forest growth. This is probably the best use for this complex of soils as most of the acreage is outside of the present levee system and are subjected to frequent overflow.

Rotations: Non-legume row crops should be followed by winter legumes .The characteristics of these soils are such that they can be used intensely for row crop production. However, the additions of crop residue and green manure crops are important to maintaining good tilth.

Fertility: They are medium acid in reaction, the available phosphate levels are medium to high, and the available potash levels are low to medium. The organic matter content is low, and good response is shown to additions of nitrogen and organic matter.

Irrigation: The slow to moderately slow infiltration rate and the high water table may cause the soils to stay wet for relatively long periods if rains follow irrigation. If this condition exists plant growth may be depressed because of the lack of aeration. Adequate surface drainage will partially eliminate this hazard. Rice may be planted and irrigated on the gentle slopes. Soils on the steeper slopes are not suited to furrow or border irrigation.

Land leveling: No ill effects should result from land leveling. The cutting of the surface soil to a uniform grade should improve surface drainage.

GROUP 7. (Land Capability Class IIs4 and IIs5)

Description of Land

General: Poorly and somewhat poorly drained, none to slightly eroded, mixed soils on nearly level (½to 2 percent slopes) relief.

Surfaces: The grayish-brown silty clay loam and silt loam surfaces range from 4 to 5 inches in thickness. Because of the high clay content, the soils are somewhat difficult to work. They are sticky and plastic when wet and hard when dry.

Subsoils: The highly mottled gray clay and silty clay subsoils allow water and air to move through them slowly. The available moisture capacity is fairly good, and root penetrations into the subsoil are shallow.

Position: These are considered to be transitional soils between the clayey and loamy soil groups. They usually occur between these two groups, but they may be found on old natural levee formations that have formed to the many shallow old stream channels scattered throughout the large areas of clay (Gumbo) soils.

Group consists of:

Land Capability Class IIs4-424 and 314.

Land Capability Class IIs5-515 and 315.

Use and Treatment

Surface drainage: The row direction should be such that each row will carry its excess water to a properly constructed outlet, but the fall for each row should be small enough to prevent erosion. A system of v-and w-type ditches located in the low areas of the field is usually sufficient to remove any excess runoff.

Subsoiling and other tillage practices: These soils have a tendency to crack during dry periods. This cracking is nature's way of subsoiling, and mechanical subsoiling has not given significant results. Because of adverse moisture conditions, land preparation for row crops may be delayed in the spring, and cultivation is often delayed by heavy rains.

Adapted crops: These are only fairly good soils for the production of cotton and if the farm has enough group one, two, four, and five soils they should be planted to cotton, and these soils should be used for some better adapted crop such as soybeans or small grains. If better soils are not available, good yields of cotton can be produced with good drainage, the right amount of fertilization, and by other good management practices.

Rotations: To maintain a desirable fertility level and to improve the physical properties of the land, the soils should be in grass and legume sods or summer legumes at least one-half of the time.

The following rotations are suggested: Grass and legume pasture sods for three years, cotton for three years; two years for soybeans, and two years for cotton; two years of oats and vetch fallowed in summer, two years of cotton; oats followed by lespedeza two years, two years for cotton. Cotton in the rotation may be replaced with corn or other non-legume row crops.

Fertility: The soil reaction is strongly to medium acid. Soil test results indicate that the available phosphate levels are medium to high with 75 percent being high, and that the available potash levels are medium. The precent of organic matter present is somewhat higher than that in the loamy soil groups.

Irrigation: They are not well suited to irrigation, but they are within the range of soils that can be irrigated. The high content of clay causes a high water holding capacity, and the poor internal drainage causes the soils to dry slowly following wetting.

Recommendations are to apply 0.5 inches per hour with sprinklers. If furrow or border systems are used, the water is applied at initial rates until the cracks are well filled, then the water is stopped and the fields drained.

Land leveling: No ill effects should result from land leveling. The cutting of the surface soil to uniform grades will improve surface drainage.

GROUP 8. (Land Capability Class IIs4)

Description of Land

General: These are grayish - brown, somewhat poorly to poorly drained, silty clay loam soils on nearly level (½ to 2 percent slopes) and gently sloping (2 to 5 percent slopes) relief.

Surfaces: The surfaces are grayish-brown silty clay loams ranging from 6 to 8 inches in thickness. They work fairly easily, but heavy rains will cause them to form slight crust when bare.

Subsoils: The mottled light grayish-brown and grayish-brown silty clay loam and silt loam subsoils cause water and air to move slowly through them. They have high water tables, the available moisture supply is good, and root penetrations are fairly deep, depending to some degree on the depth to the water table.

Position: They occur in small to fairly large areas on recently deposited sediments.

Group consists of: 524, 524B, T524, and T524B.

Use and Treatment

Surface drainage: The nearly level soils (soil types 524 and T524) need improvised surface drainage including protection from floodwater. Row direction should be such that each row will carry its excess water to a properly constructed outlet. V-and w-type ditches located in the low areas of the fields emptying into larger ditches (dragline) are usually needed to carry excess water to a primary drainage system.

The gently sloping soils (soil types 524B and T524B) do not need artificial surface drainage. Row direction is best on the contour.

Subsoiling and other tillage practices: These soils contain a relatively high amount of clay, although they do not crack as do the soils in group 7. Compacted areas (plow-soles) may form just under the plow layer. When found, these compacted layers should be broken during dry weather in the late fall months. Seedbed preparations should be deep and is best done in the spring. Freqeunt cultivation will improve aeration.

Adapted crops: The production of soybeans, corn, and hay crops or pasture are the best uses for these soils. If adequate surface drainage is provided, cotton is adapted, but planting dates may be delayed because of the poor drainage. Because small grains, winter legumes, and winter grazing crops are growing during the months of normally high rainfall, they may produce low yields unless the surface drainage is improved.

Rotations: To maintain a desirable fertility level and to improve the physical condition of the land, these soils should be in grass and legume sods or summer legumes part of the time. Following are some suggested rotations: Three years of grass and legume pasture, three years for cotton; two years for soybeans, two years for cotton; two years of oats followed by lespedeza, two years of cotton.

Fertility: This group responds well to the additions of organic matter and nitrogen. Soil test results indicate that the available phosphate levels are medium, the available potash levels are low, and the organic matter content is low.

Irrigation: The physical properties, except surface texture, are similar to those of soils in group 7. Follow suggested recommendations for that group.

Land leveling: Cutting the surface to uniform grades should reduce excess runoff on the steeper slopes and improve surface drainage on the more level slopes. No significant changes in physical properies will result, unless very deep cuts are made.

GROUP 9. (Land Capability Classes IIs4, IIIe5, and IIIe6)

Description of Land

General: Poorly and somewhat poorly drained, slightly and moderately eroded, clayey and mixed soils on gently sloping (2 to 5 percent slopes) and sloping (5 to 8 percent slopes) relief.

Surfaces: The dark grayish-brown and grayish-brown clays, silty clays, and silty clay loam surfaces range from 3 to 5 inches in thickness. They are difficult to work, seedbed preparation is often delayed in the spring, and cultivation is often delayed following heavy rains. Because of the high clay content, the soils are sticky and plastic when wet, hard when dry, and they erode readily when bare.

Subsoils: The subsoils are highly mottled gray to light brownish-gray clay and silty clay. Water and air move through them very slowly, and root penetrations are shallow.

Position: They occur on the stronger slopes of the slackwater (Gumbo) areas and on the slopes of some old natural levees.

Group consists of:

Land Capability Class IIs4, 314B, 424B, 312B, 340B, 340B2, and 423B.

Land Capability Class IIIe5, — 314C, 424C2, and 424B2.

Land Capability Class IIIe6 — 312C, 340C, 340C2, and 340B2.

Use and Treatment

Surface drainage: The row direction should be on the contour; generally this is parallel to the ridges, to prevent erosion. However, runoff is high and the fall should be enough to remove excess water during periods of heavy rainfall. Because of the uneven slopes, excess water tends to collect in the low areas (usually the low swags) of some fields. A system of v-and w-type ditches located in these low areas will usually afford adequate surface drainage.

Subsoiling and other tillage practices: The cracking of the soils during dry weather is nature's way of subsoiling. Mechanical subsoiling has not given significant results. Deep land preparation and the use of relatively high seedbeds will improve aeration and row drainage. Fall preparation of seedbeds may increase the erosion hazard, but if seedbeds are prepared in the fall the freezing and thawing and wetting and drying through the winter months improves soil structure.

Adapted crops: Pasture, small grains, and soybeans are some of the better crops for these heavy textured sloping soils. However, the soils of this group on the gently sloping relief (soils whose mapping symbols end with the letter B) have good surface drainage and will produce good yields of cotton, except during wet years.

Rotations: If these soils are needed for non-legume row crops, the following rotations are suggested: Four years of pasture, and two years for row crops; two years of soybeans, and one year of non-legume row crops; two years of oats and vetch, and one year of row crops.

Fertility: The soil reaction ranges from strongly to medium acid. Soil test results indicate that the available phosphate levels are medium to high and the available potash levels are low to high. They respond well to additions of nitrogen and organic matter.

Irrigation: The steep slopes are not suited to furrow or border irrigation. They can be irrigated with sprinklers. The slopes result in faster runoff, and this group will not have the plant growth hazard as the same soil types on more level slopes.

Land leveling: Because of the steep slopes, land leveling is not recommended.

GROUP 10. (Land Capability Classes IIs4, IIIs4, and IVw11)

Description of Land

General: Poorly drained, none to very slightly eroded, clay soils on level (0 to ½ percent slopes) and nearly level (½ to 2 percent slopes) relief.

Surfaces: The surfaces are dark grayish-brown and grayish-brown clays and silty clays, ranging from 2 to 5 inches in thickness. They are difficult to work, and they are very sticky and plastic when wet and very hard when dry.

Subsoils: The subsoils are highly mottled gray clays. When wet, water and air move through them very slowly, and root penetrations are shallow.

Position: They are usually found in large areas on slackwater deposits.

Group consists of:

Land Capability Class IIs4 — 423.

Land Capability Class IIIs4 — 312 and 300.

Land capability Class IVw11—312A°.

Use and Treatment

Surfaces drainage: Drainage is an important factor if these soils are to be farmed successfully. Row direction should be such that each row will carry its excess water to adequate outlets. V-and w-type ditches emptying into larger ditches are necessary to remove excess surface water.

Subsoiling and other tillage practices: The cracking of the soils in dry weather is nature's way of subsoiling. Mechanical subsoiling is not necessary. Deep seedbed preparation in the fall of the year is recommended.

Adapted crops: These are excellent soils for the production of rice, but only a small acreage can be planted to rice. Soybeans and pasture are some of the better uses for the land. Many farms are wholly on this group of soils. Under this situation the soils with the best surface drainage should be planted to cotton. Surface drainage, the right kind and amount of fertilizer, and the preparation of seedbeds in the fall of the year are some important practices that help to insure better yields of cotton.

Rotations: The soils are difficult to manage. The growing of winter legumes for green manure is hazardous because this practice requires the preparation of seedbeds in the spring. To maintain the physical condition of the soil and to insure the best yields, this land should be planted two-thirds of the time in other than clean tilled row crops.

Some good rotations are: Four years of grass and legume pasture sod, and two years of row crops; two years of soybeans or oats and lespedeza, and one year of cotton; two years of rough peas for seed, and one year of cotton; two years of rice, two or three years of pasture, and two years of cotton.

Fertility: The organic matter content is somewhat higher than that of the loamy soil groups. However, the soils respond well to additions of nitrogen and organic matter. Soil test results indicate that the available phosphate and potash levels are medium to high with about 80 percent having levels of phosphate and about 70 percent having high levels of potash. The soil reaction is strongly to medium acid.

Irrigation: Because of the fine texture and poor internal drainage, this group barely falls within the range that can be irrigated. They are excellent soils for rice irrigation, but other crops have been irrigated with varying results. More research is needed to determine their response to irrigation.

Land leveling: No ill effects should result from land leveling. However, the average organic matter content of the plow layer is 2.6 percent as compared to an average of 1.1 percent for the first one foot of subsoil. Since the physical condition of the soil is poor, and organic matter tends to improve the poor physical condition, a crop that will increase the organic matter content is desirable following land leveling.

GROUP 11. (Land Capability Classes IIw3, and IIIw13)

Description of Land

General: These poorly drained mixed soils occur in low swags (depressions) and accumulate rather than lose soil from erosion.

Surfaces: Because of the colluvial deposits received from the surrounding higher land, the surfaces range widely in color, texture, and thickness. The textures range from clays to silt loams; the thickness ranges from 3 to many inches.

Subsoils: They have mottled dark-gray clayey subsoils. Water and air move into and through the soil slowly, and plant root penetrations are shallow. The available moisture is good.

Position: They occur in long narrow low swags (depressions) scattered throughout the loamy and mixed soils.

Group consists of:

Land Capability Class IIw3 — 235 and 236.

Land Capability Class IIIw13—220 and 620.

Use and Treatment

Surface drainage: Surface runoff from higher elevations collects in the low swags, and before these soils can be properly used for field crops, surface drainage must be provided. These low swags are part of the natural drainage pattern of the area and should be used primarily for the location of v-and w-type ditches and secondarily for crop production.

Subsoiling and other tillage practices: Subsoiling has not given significant results. Adverse moisture conditions may delay seedbed preparation in the spring and cultivation of crops following heavy rain.

Adapted crops: The production of such row crops as cotton and corn involves a certain amount of risk. However, because of their small size, it may be necessary that they be farmed the same as the adjacent soils.

If adequate drainage is provided, these soils can be used for the production of soybeans, sorghums, hay crops, and temporary pastures.

Rotations: Because of the drainage problem and small size, rotations may be difficult to follow. Usually they are planted to the same crops as the surrounding soils.

Fertility: Local flooding prevents these soils from being the most productive spots in the field. They have accumulated fertility from adjacent higher land. The soil reaction ranges from medium to slightly acid. Soil test results indicate that the available phosphate and potash levels are high. The organic matter percent is moderately high, and they require less nitrogen than most soils of the county.

Irrigation: This group of soils is in a class that is not well suited to irrigation, but they can be irrigated by either sprinkler, border or furrow type systems. The poor internal drainage conditions cause a hazard to crops if heavy rains fall following irrigation. Because of the variations in soil properties, the water holding capacity, intake rate, and other factors will vary widely.

Land leveling: These soils occur in the low swags and usually receive fill when a field is leveled. Usually this filling improves the surface texture but does not change the poor internal drainage. The improved surface drainage reduces the hazard to crops if heavy rains follow irrigation. The filling of these areas has had varying influence on yields. During some years yields have been increased, while in other years the yields have been reduced.

GROUP 12. (Land Capability Class IVw1)

Description of Land

General: Very poorly drained clays in low swags (depressions). They accumulate rather than erode.

Surfaces: The surfaces are very dark gray clays. Because of the accumulation of soil material, the thickness varies.

Subsoils: They have dark gray clay subsoils through which water and air move very slowly, and root penetrations are shallow.

Position: These soils occur throughout the slackwater areas.

Group consists of: 212.

Use and Treatment

Surface drainage: The location of the soils in the low swags makes them invaluable as guides for locating ditches and canals. However, the clay subsoils, depressed position, and lack of adequate outlets make artificial surface drainage difficult. V-and w-type ditches and dragline ditches, in addition to row arrangement, are necessary to prevent ponding and provide for the removal of excess surface water.

Subsoiling and other tillage practices: Subsoiling is not recommended. Planting and cultivation of row crops is often delayed because of adverse moisture conditions.

Adapted crops: Forest is probably the best adapted use. With the best of surface drainage, the more shallow areas may be used for rice, fescue, bermuda grass and some of the summer grasses.

Fertility: The poor physical condition and the accumulation of excess surface water keep these soils from being the most productive. The soil reaction ranges from strongly to medium acid. Soil test results indicate that the available phosphate and potash levels are high, and that the organic matter content is fairly high. They require less nitrogen than any of the other soil groups.

Irrigation: Because surface water tends to pond, they are difficult to drain, and most row crop production is hazardous; irrigation on most crops is not recommended. If surface drainage is adequate, rice and late pasture crops may be irrigated.

Land leveling: Usually these low swags receive fill when fields are leveled. This improves surface drainage and may improve surface texture. It is not recommended that they be leveled unless they are a part of a larger area that is being leveled.

GROUP 13. (Land Capability Classes IIIw6, IIIw12, and IVw2)

Description of Land

General: Overflow soils on level (0 to ½ percent slopes), nearly level (½ to 2 percent slopes), and gently sloping (2 to 5 percent slopes) relief.

Surfaces: The surface textures are clays, silty clays, and silty clay loams with the clay and silty textures occupying the largest total area.

Subsoils: The highly mottled gray clay and silty clay subsoils allow water and air to move through them slowly, and root penetrations are shallow.

Position: They occur in areas subject to backwater flooding, usually caused by the overflowing of the Yazoo and Quiver Rivers or their tributaries.

Use and Treatment

Surface drainage: They are often covered with floodwater for several weeks during the winter and spring months. Until this condition is changed, artificial surface drainage will not be effective.

Adapted crops: Trees are probably the best adapted crop until the overflow hazard is eliminated. The overflow water may not recede in the spring until the desired planting date for many crops has passed. In other years cotton may be planted and cultivated one or more times, then the overflow waters come and kill the crops. However, cotton may be successfully grown some years. Where the soils have been cleared, soybeans, sorghum, millet and sudan grass are sometimes grown with variable results.

Fertility: The soils will give good response to applications of nitrogen on nonlegume crops. The soil reaction ranges from medium to strongly acid. Soil test results indicate that the available phosphate and potash levels range from medium to very high. The organic matter content, especially on the soils that have not been cleared, is high. This high content of organic matter will be reflected in higher yields, good physical condition, and faster intake of water for a few years after they are cleared.

Group consists of: If the overflow hazard is ever eliminated, these soils will respond as follows:

Land Capability Class IVw2 — 212f will respond to the same use and treatment as soil group 12.

Land Capability Class IIIw6 — 314f and 424f will respond to the same use and treatment as soil group 7.

Land Capability Class IIIw12—312A°f, 312f, 300f, and 012 will respond to the same use and treatment as soil group 10. 340Bf and 312Bf will respond to the same use and treatment as soil group 9.

Land Capability Class IIIw14 — 220f will respond to the same use and treatment as soil group 11.

GROUP 14. (Land Capability Class VIIs1)

Description of Land

General: Excessively drained sands on nearly level (½to 2 percent slopes) relief. There is no erosion.

Surfaces: The surfaces are grayish colored sands.

Subsoils: These sandy subsoils allow rapid movement of water and air through them, and root penetrations are deep. Because of the low water holding capacity, these soils are too droughty for most commonly grown crops.

Position: They occur in small to large areas near Big Sand, Abiacha, and Palusha Creeks.

Percent of county: Less than one percent.

Group consists of: 579 and T439+.

Use and Treatment

Surface drainage: No surface drainage is needed. However, protection from overflow water is needed.

Adapted crops: This land is not suited to row crops. Bermuda grass may be grown, but difficulties may be encountered in obtaining good stands from seeding. Willow, cottonwood, and sycamore trees will grow.

Rotations: Some success may be had in overseeding of white or crimson clover, or vetch.

Fertility: They are low in all plant nutrients and organic matter. Applications of all fertilizers should be in small amounts at close intervals.

Land Capability Classes of Leflore County

Several different colors appear on the land capability maps. In Leflore County there may be as many as five colors. Each color tells you about the land, whether it is suited to cultivation or not, and the general degree of difficulty or risk that is involved in its safe use and management. Each color shows one of five classes of land that are called land capability classes. The classes are distinguished by Roman numerals as well as the colors. Table 5 shows the safe use of the land of each class, and the color that represents the class.

Classes I, II, and III include the land that is suited for regular cultivation, and

Class IV the land that can be safely cultivated in a limited way. Class VII includes the land that is not suited for cultivation but is suited for grazing or forestry.

Here are descriptions of the five land capability classes:

Class I is very good land from all points of view. It is nearly level and does not erode easily. The soil is deep and easy to till. It holds water well and is fairly well supplied with plant nutrients. Such land is scarce in many localities and is not found at all on some farms. Anyone who is fortunate enough to have Class I land can use it safely in almost any way he chooses. Of course, it should be managed so that a good supply of plant nutrients and good physical condition are maintained.

The other classes are farmed with greater difficulty or greater risk than the Class I land.

Class II is good land, but certain physical conditions make it not quite so good as Class I land. The slope may be just steep enough to make water run off at speeds which will carry away soil. Some Class II land is naturally wet and requires drainage. Some has not quite as good water holding capacity as Class I land. Each of these characteristics either limits the use of the land to some extent or requires some special attention year after year. Even a single farm may have two or more variations of Class II land.

Since Class II land has some moderate use limitations, some special treatments are called for, such as easily applied practices like contour tillage, protective cover crops, simple water management, and crop rotations.

Class III is moderately good land for cultivation. It is more limited in use than Class II land by reason of one or more natural features. It can be used regularly for crops but because of these natural restrictions, intensive treatment of some kind is called for. Several variations occur within Class III as they do in Class II. Some Class III land is moderately sloping and must have intensive care to control erosion and conserve moisture if used for crops. Another variation of Class III calls for water management because of poor drainage. The greatest part of the Class III land in Leflore County is wet land that requires intensive drainage practices.

When you see red color on a land capability map, you know at once that designates Class III land and also that the best of farming methods are required. A land capability map tells at a glance how much Class III land is on a farm and where it is located on the farm. Under the present coloring system used in Leflore County, it does not tell the variety of Class III land on the farm.

Class IV land is good enough for occasional cultivation under careful management, but it is not suited for regular production of cultivated crops. In Leflore County all Class IV land is too wet for regular cultivation because of the accumulation of local water, or because of backwater flooding. As flood control work in the Yazoo-Basin progresses, some land that is now flooded may be protected from flood waters. If this land is protected to the extent that it can be used for regular cultivation, it will become either Class II or Class III land.

Class VII land is not suitable for cultivation. In Leflore County all Class VII land is droughty because of the coarse texture of the deep sands. Fortunately, the total area of Class VII land in the county is very small. It is limited for grazing but is good forest land.

The map tells more than land capability classes. Physical features of the land that may make its use difficult or risky determine the land capability class. Some land is subject to impoverishing erosion if it is not protected. Other land is naturally wet, so that drains must be installed or maintained if crops are to be grown. Some land is shallow or has other special soil conditions. These three kinds of land limitations make up the three possible subclasses of land within each of the land capability classes. These subclasses are indicated by lower case letters e, w, and s, see table 4.

Within Class II and Class III land, for example, all three of these land capability subclasses occur. All Class III land is rather severely limited in its use, although it is suited for regular cultivation. Often all three of these subclasses — wet land, sloping land, and land with special soil conditions — are found on a single farm. The land capability map shows the subclasses. It also shows, by means of the mapping symbols, significant variations in the subclasses.

Soil Series and Soil Types of Leflore County

Alligator Series

The Alligator series consists of light-colored, very plastic, poorly drained soils formed on fine textured alluvium. They are found in the slackwater areas of the floodplain and are locally called gumbo or buckshot soils. The reaction ranges from medium to very strongly acid, and the phosphate and potash levels range from medium to high. The organic matter content is relatively high, and they are found in many localities in the county.

Soil types within the Alligator series:
312 Alligator clay
314 Alligator silty clay loam
315 Alligator silt loam

Soil profile: (312 Alligator clay). The surface layer is a dark gray or dark grayish-brown clay, very plastic when wet, firm when moist, and very hard when dry, and 2 to 4 inches thick. Just beneath the surface layer is a gray layer, prominently mottled with yellowish brown very plastic when wet, very firm when moist, and very hard and extremely hard when dry. The whole profile is slowly permeable to water. Other than a difference in surface texture, Alligator clay, Alligator silty clay loam, and Alligator silt loam have similar profiles.

Bosket Series

The Bosket series consists of well to somewhat excessively drained soils formed on medium to moderately coarse-textured alluvium. The relief is nearly level to sloping, and they are found on the higher altitudes of the old natural levee formations. They have been free from overflow waters long enough to have some profile development and long enough to be partly leached. The reaction is medium to slightly acid, the phosphate level is medium to high, the potash level is low to medium, and the organic matter content is low. These soils are found in small areas and have a very small total acreage in the county.

Soil types within the Bosket series:
456 Bosket very fine sandy loam.

Soil profile: The surface layer is a light brownish-gray, very friable, very fine, sandy loam, 6 to 9 inches thick. The subsoil is a dark brown to light yellowish-brown, friable sandy clay loam, moderately permeable to water, 12 to 16 inches thick. Below the subsoil is a layer of light yellowish-brown, friable very fine sandy loam to very friable sandy loam.

Beulah Series

The Beulah series consists of excessively drained soils formed on moderately coarse-textured alluvium. They are free from overflow waters, but because of the moderately coarse-texture they have very little profile development. The relief is level to gently sloping, and they are found on the highest altitudes of the old natural levee formations. The reaction is medium to slightly acid, the phosphate level is medium to high, the potash level is medium, and the organic matter content is low. These infrequently found soils have a very small total acreage in the county.

Soil types within the Beulah series:
466 Beulah very fine sandy loam.
467 Beulah fine sandy loam.

Soil Profile: (Beulah very fine sandy loam). The surface layer of soil is a light grayish-brown, very friable, very fine sandy loam, 6 to 10 inches thick. The subsoil is a dark brown to yellowish-brown, friable, very fine sandy loam, 14 to 18 inches thick. Below the subsoil is a light yellowish-brown, very friable, fine sandy loam or very friable sandy loam. The whole profile is rapidly permeable to water. Except for the difference in the surface texture, Beulah very fine sandy loam and Beulah fine sandy loam have like profiles.

Collins Series

The Collins series are somewhat poorly to moderately well drained soils formed on stratified beds of medium-textured recently deposited alluvial sediments. They are subject to overflow waters and have very little profile development. The relief is level, and they are found on first bottom positions. They have a high water table and are moderately permeable to water. The soil reaction is strongly to -medium acid. The phosphate level is medium to high, the potash level is low to medium and the organic matter content is very low. These soils are found near the streams in the eastern part of the country, and the total acreage is small.

Soil types within the Collins series:
535 Collins silt loam.

Soil Profile: The surface layer is a light yellowish-brown to grayish-brown, friable silt loam, 7 to 10 inches thick. Beneath the surface layer of soil is a layer of yellowish-brown, friable silt loam, 10 to 24 inches thick. Below layer two is a light gray, friable silt loam mottled with yellowish-brown, that extends to 40 inches or more in depth.

Dowling Series

The Dowling series consist of poorly drained soils formed partly from local alluvium and partly from slackwater deposits. They are found in the low swags (depressions) and are frequently covered with water. They have a high water table and are very slowly permeable to water. The soil reaction is strongly to medium acid, the phosphate and potash levels are high, and the organic matter content is relatively high. Each soil type has an overflow phase.

Soil types within the Dowling series:
212 Dowling clay.
212 Dowling soils.

Soil Profile: (212 Dowling clay). The surface layer of soil is a dark grayish-brown, plastic to very firm clay, 4 to 6 inches thick. Beneath the surface layer of soil is a layer of gray to very dark gray, plastic clay, 16 to 26 inches thick. Below layer two is a layer of gray, very plastic clay that extends to 60 inches or more in depth. Except for the surface layer of soil, Dowling clay and Dowling soils have similar profiles.

Dubbs Series

The Dubbs series consists of moderately well to well drained soils formed on stratified beds of fine to moderately coarse-textured alluvium. The relief ranges from nearly level to sloping, and they are found on the higher altitudes of the old natural levee formations. They have been free from overflow waters long enough to have some profile development and long enough to be partly leached. The reaction is strongly to slightly acid, the phosphate level ranges from medium to high, the potash level ranges from low to medium, and the organic matter content is low.

Soil types within the Dubbs series:
445 Dubbs silt loam.
446 Dubbs very fine sandy loam.

Soil Profile: (446 Dubbs very fine sandy loam). The surface layer is a grayish-brown to brown, very friable, very fine, sandy loam, 4 to 8 inches thick. The subsoil is a yellowish-brown to dark brown, firm to friable silty clay loam or sandy clay loam, moderately permeable to water, 24 to 26 inches thick. Below the subsoil is a yellowish-brown, very friable layer that ranges in texture from a very fine sandy loam to a sandy loam. The profile has only a few faint mottlings or discolorations. Other than the difference in the surface texture, Dubbs very fine sandy loam and Dubbs silt loam have similar profiles.

Dundee Series

The Dundee series consist of somewhat poorly to moderately well drained soils formed on stratified beds of medium to fine-textured alluvium. The relief ranges from nearly level to sloping, and they are found on the old natural levee formations. They have been free from overflow waters long enough to be partially leached, and long enough to have some profile development. The soil reaction is strongly to slightly acid, the phosphate level ranges from medium to high, the potash level ranges from low to medium, and the organic matter content is low.

Soil types within the Dundee series:

434 Dundee silty clay loam.
435 Dundee silt loam.
436 Dundee very fine sandy loam.

Soil Profile: (436 Dundee very fine sandy loam). The surface layer is a pale brown to dark yellowish-brown, very friable, very fine, sandy loam, 4 to 7 inches thick. The subsoil is a brown to yellowish-brown, firm to friable silty clay to sandy clay loam, slightly mottled with yellowish-brown and brownish-gray, moderately permeable to water, 16 to 24 inches thick. Below the subsoil is a yellowish-brown layer of silty clay loam to sandy clay loam material, faintly to distinctly mottled with shades of yellow and brown. Dundee silty clay loam has a slightly finer textured profile throughout than the Dundee very fine sandy loam.

Forestdale Series

The Forestdale series consist of poorly to somewhat poorly drained soils formed on stratified beds of medium to fine-textured alluvium. The relief ranges from nearly level to sloping, and they are found on the lower altitudes of the old natural levee formations. Forestdale silty clay loam has an overflow phase, a shallow phase, and a moderately shallow phase. Forestdale silt loam has an overwash phase. The soil reaction is strongly to slightly acid, the phosphate level is medium to high, the potash level is low to medium, and the organic matter content is low to moderately low.

Soil types within the Forestdale series:

423 Forestdale silty clay.
424 Forestdale silty clay loam.
425 Forestdale silt loam.
426 Forestdale very fine sandy loam.

Soil Profile: (Forestdale silt loam). The surface layer is a brown to yellowish-brown, friable silt loam, 4 to 6 inches thick. The subsoil is a light gray to light brownish-gray, firm silty clay, distinctly mottled with shades of gray, yellow, and brown; slowly permeable to water, 20 to 24 inches thick. Beneath the subsoil is a gray layer of silty clay loam material, distinctly mottled with shades of yellow, gray and brown. Forestdale silty clay and Forestdale silty clay loam are somewhat finer textured throughout the profile than Forestdale silt loam. Other than the texture of the surface layer of soil, Forestdale silt loam and Forestdale very fine sandy loam have similar profiles.

Falaya Series

The Falaya series consist of somewhat poorly drained soils formed on beds of medium to moderately fine-textured recently deposited alluvium. The relief is nearly level to gently sloping. They are subject to overflow and have very little profile development. The water table is high, and they are slowly permeable to water depending in large measure upon the depth to the water table. The soil reaction ranges from strongly acid to slightly acid, the phosphate level ranges from medium to high, the potash level ranges from low to medium, and the organic matter content is low. The total acreage of these soils comprises a small percent of the total acreage of the county.

Soil types within the Falaya series:

525 Falaya silt loam.
524 Falaya silty clay loam.

Soil Profile: (525 Falaya silt loam). The surface layer is a grayish-brown, very friable silt loam, 4 to 10 inches thick. Beneath the surface layer is a pale yellow to grayish-brown, friable to firm silt loam or silty clay loam, mottled with shades of yellow and brown, 6 to 12 inches thick. Below layer two is a layer of light gray to gray, friable to firm silt loam or silty clay loam, distinctly mottled with shades of gray and brown, 24 or more inches thick. Other than the difference in surface texture, Falaya silty clay loam and Falaya silt loam have like profiles. Both Falaya silt loam and Falaya silty clay loam have a modertely shallow and a shallow phase.

Hymon Series

The Hymon series consist of moderately well drained soils formed on medium to moderately coarse-textured mixed alluvial sediments. The relief is nearly level to gently sloping. They are subject to overflow and have very little profile development. They have a fluctuating water table, and they are slowly to moderately rapidly permeable to water, depending upon the depth to the water table. The soil reaction ranges from strongly to slightly acid, the phosphate level is medium to high, the potash level is low to medium, and the organic matter content is low.

Soil types within the Hymon series:

T536 Hymon very fine sandy loam.
T535 Hymon silt loam.
T539 Hymon sand.

Soil Profile: (T536 Hymon very fine sandy loam). Hymon very fine sandy loam is the dominate type. The surface layer is a pale brown to brownish-yellow, very friable, very fine, sandy loam, 10 to 24 inches thick. Beneath the surface layer is light brownish-gray to brownish-yellow, very friable, very fine sandy loam or silt loam material, prominently splotched with shades of brown and yellow, 2 to 3 feet in thickness. The different layers may be alternating layers of very fine sandy loam and silt loam sediments.

Hymon very fine sandy loam has a moderately shallow phase, and Hymon sand is an overwash phase.

Ina Series

The Ina series consist of somewhat poorly drained soils formed on medium to moderately coarse-textured recently deposited mixed sediments. The relief is nearly level to gently sloping. They are subject to overflow and have very little profile development. The water table fluctuates, and they are slowly to moderately slowly permeable to water, depending upon the depth to the water table. The soil reaction is strongly to slightly acid, the phosphate level is medium, the potash level is low, and the organic matter content is low. They are found in small areas, and the total acreage is small.

Soil types within the Ina series:

T526 Ina very fine sandy loam.
T525 Ina silt loam.
T524 Ina silty clay loam.

Soil Profile: (T526 Ina very fine sandy loam). Ina very fine sandy loam is the dominate soil type. The surface layer is a brown to light yellowish-brown, very friable, very fine, sandy loam, slightly mottled with shades of gray, yellow and brown, 6 to 12 inches thick. Beneath the surface layer is a layer of light gray to yellowish-brown, friable silt loam, distinctly mottled with shades of gray and brown, 10 to 20 inches thick. Below layer two is light-gray, friable silt loam material, prominently mottled with shades of gray and brown, and may range up to several feet in thickness. Layers two and three may be alternating layers of silt loam and very fine sandy loam.

Ina very fine sandy loam has a shallow and moderately shallow phase. Ina silt loam is the only soil type, within the Ina series, whose slope ranges in steepness above the nearly level phase.

Pearson Series

The Pearson series consist of moderately well drained soils formed on stratified beds of medium-textured alluvial sediments. They are on nearly level to gently sloping relief, and they are found on old natural levee formations formed to the small streams that flow from the Loess Belt on the eastern side of the flood plain. Organic matter content and native fertility are low, and the soil reaction is very strongly to strongly acid. The total acreage is very small.

Soil types within the Pearson series:
835 Pearson silt loam.

Soil Profile: (835 Pearson silt loam). The surface layer is dark brown to yellowish-brown, very friable, silt loam, 4 to 6 inches thick. Beneath the surface layer is dark brown to strong brown friable silt loam with moderate medium subangular blocky structure, moderately permeable to water, 18 to 24 inches thick. Below the subsoil is a layer of yellowish-brown friable silt loam, mottled with strong brown and containing many concertions.

Souva Series

The Souva series consist of poorly drained soils formed partly from local alluvium and partly from slackwater deposits. They are found in the low swags and collect water from the adjoining soils. The water table is high and they are slowly permeable to water. They are infrequenlty found and the acreage is small.

Soil types within the Souva series:
235 Souva silt loam.
236 Souva very fine sandy loam.

Soil Profile: (235 Souva silt loam). The surface is a dark grayish-brown, very friable silt loam, 6 to 14 inches thick. Beneath the surface layer is dark-brown, friable silty clay loam or sandy clay loam material, mottled with shades of gray, yellow, and brown, 10 to 20 inches thick. Beneath layer two is found light gray, plastic silty clay material, mottled with shades of yellow and brown, that extends to 42 inches or more in depth. Except for the difference in the surface layer of soil, Souva silt loam and very fine sandy loam have similar profiles.

012 Alligator-Dowling Clays

In some of the large wooded areas of the county, Alligator clays and Dowling clays are not separated. The relief is level to nearly level, and most all of these areas are subject to annual overflows. Because of the level and nearly level relief and the annual overflow hazard, they are difficult to drain and cultivate. The Alligator soils occur on broad level and nearly level relief interwoven with the Dowling soils (low swags).

300 Alligator-Dowling-Forestdale Soils

In some large wooded areas of the county, Alligator, Dowling, and Forestdale soils were not separated. The Alligator clay and silty clay loam and Forestdale silty clay, silty clay loam, and silt loam soils are interwoven by Dowling soils in the low swags. Clay, silty clay, and silty clay loam surface textures predominate. The relief is level to gently sloping, and an overflow phase has been mapped.

460 Dundee-Bosket Soils

These moderately well to somewhat excessively drained soils are found in mixed patterns on the old natural levee formations, and were mapped together as a complex. Dundee and Dubbs soils are dominate in the mapping units, silt loam and very fine sandy loams are the predominate surface textures, and the slope ranges from gently sloping to sloping.

340 Forestdale-Alligator Soils

These poorly to somewhat poorly drained soils occur mixed in pattern near stream banks and on some of the steeper slopes. The Alligator soils were formed on beds of fine-textured alluvium; whereas, the Forestdale soils were formed on stratified beds of fine and medium-textured alluvium. The surface textures are clay, silty clay, and silty clay loams, the relief ranges from gently sloping to sloping, and an overflow phase has been mapped.

500 Falaya-Ina-Hymon Soils

These soils include wooded areas of poorly to moderately well drained soils that occur in mixed pattern and are mapped as a complex. The slope ranges from nearly level to gently sloping, and they are subject to frequent overflow. The surface textures are silty clay loams, silt loams, and very fine sandy loams. They need protection from the overflow hazard if crops are to be cultivated.

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Estimated average yields of principal crops under good management for the soils of Leflore County.

Soil symbol	Soil group	Soil Name	Cotton (lint lbs. per acre)	Corn hybrid (bu. per acre)	Soybeans (bu. per acre)	Rice (bu. per acre) 1	Oats (bu. per acre)	Pasture (acres animal units)	Page
012	13	Alligator-Dowling soils	----	----	----	----	----	----	32
212	12	Dowling clay	----	----	----	70	----	3.5	32
212f	13	Dowling clay, overflow phase	----	----	----	----	----		32
220	6	Dowling soils	250	35	20	70	----	2.5	26
220f	13	Dowling soils, overflow phase	----	----	----	----	----	----	32
235	6	Souva silt loam	350	45	20	60	----	2.5	26
236	6	Souva very fine sandy loam	350	45	20	60	----	2.5	26
300	10	Alligator, Dowling, and Forestdale soils		----	25	70	30-55	3.0	30
300f	13	Alligator, Dowling, and Forestdale soils	----	----	----	----	----	3.5	32
312	10	Alligator clay, nearly level phase	400	45	25	70	45-65	3.0	30
312A°	10	Alligator clay, level phase	250	20	17	70	----	3.5	30
312A°f	13	Alligator clay, level overflow phase	----	----	----	----	----	----	32
312f	13	Alligator clay, nearly level overflow phase	----	----	----	----	----	----	32
312B	9	Alligator clay, gently sloping phase	450	45	25	70	45-65	3.0	29
312Bf	13	Alligator clay, gently sloping overflow phase	----	----	----	----	----	----	32
312C	9	Alligator clay, sloping phase	----	----	----	----	----	3.5	29
314	7	Alligator silty clay loam, nearly level phase	450	50	25	70	45-60	2.8	27
314f	13	Alligator silty clay loam, nearly level overflow phase	----	----	----	----	----	3.5	32
314B	9	Alligator silty clay loam, gently sloping phase	400	45	25	60	45-65	2.8	29
414C	9	Alligator silty clay loam, sloping phase	----	----	----	----	----	3.0	29
315	7	Alligator silt loam, nearly level phase	450	50	25	70	45-65	3.0	27
340B	9	Alligator-Forestdale soils, gently sloping phases	----	----	----	----	35-55	3.0	29
340Bf	13	Alligator-Forestdale soils, gently sloping overflow phases	----	----	----	----	----	3.5	32
340B2	9	Alligator-Forestdale soils, eroded gently sloping phases	----	----	----	----	30-55	3.0	29

INDEX—(Cont.)

Estimated average yields of principal crops under good management for the soils of Leflore County.

Soil symbol	Soil group	Soil Name	Cotton (lint lbs. per acre)	Corn hybrid (bu. per acre)	Soybeans (bu. per acre)	Rice (bu. per acre) 1	Oats (bu. per acre)	Pasture (acres animal units)	Page
340C	9	Alligator-Forestdale soils, sloping phases	------	----	----	----	30-55	3.0	29
340C2	9	Alligator-Forestdale soils, eroded sloping phases	------	----	----	----	25-50	3.5	29
423	10	Forestdale silty clay, nearly level phase	400	45	25	70	45-65	3.0	30
423B	9	Forestdale silty clay, gently sloping phase	450	45	25	----	45-65	3.0	29
424	10	Forestdale silty clay loam, nearly level phase	450	45	25	70	45-60	2.7	30
424f	13	Forestdale silty clay loam, nearly level overflow phase	------	----	----	----	--------		32
424B	14	Forestdale silty clay loam, gently sloping phase	425	40	20	----	45-60	2.8	33
424B2	14	Forestdale silty clay loam, eroded gently sloping phase	400	35	20	----	45-60	2.5	33
424C2	14	Forestdale silty clay loam, eroded sloping phase	------	----	----	----	30-55	3.0	33
425+	8	Forestdale silt loam, nearly level overwash phase	500	65	25	65	45-60	2.5	28
425	8	Forestdale silt loam, nearly level phase	500	65	25	65	45-60	2.5	28
425B	8	Forestdale silt loam, gently sloping phase	400	50	20	----	45-60	2.8	28
425B2	8	Forestdale silt loam, eroded gently sloping phase	350	45	20	----	40-55	2.8	28
426	8	Forestdale very fine sandy loam, nearly level phase	550	70	25	70	45-65	2.5	28
426B	8	Forestdale very fine sandy loam, gently sloping phase	75	50	20	----	45-65	2.8	28
434	4	Dundee silty clay loam, nearly level phase	525	60	25	60	40-60	2.5	24
434B	5	Dundee silty clay loam, gently sloping phase	475	50	20	----	40-60	2.8	25
434B2	5	Dundee silty clay loam, eroded gently sloping phase	450	45	20	----	40-60	2.8	25
434C	5	Dundee silty clay loam, sloping phase	------	----	----	----	--------	3.0	25
434C2	5	Dundee silty clay loam, eroded sloping phase	------	----	----	----	--------	3.0	25
435+	1	Dundee silt loam, nearly level overwash phase	650	85	20	----	35-65	2.3	21
435	1	Dundee silt loam, nearly level phase	650	85	20	----	35-65	2.3	21
435B	3	Dundee silt loam, gently sloping phase	500	60	15	----	35-65	2.5	23
435B2	3	Dundee silt loam, eroded gently sloping phase	500	55	12	----	35-65	2.5	23

INDEX—(Cont.)

Estimated average yields of principal crops under good management for the soils of Leflore County.

Soil symbol	Soil group	Soil Name	Cotton (lint lbs. per acre)	Corn hybrid (bu. per acre)	Soybeans (bu. per acre)	Rice (bu. per acre) 1	Oats (bu. per acre)	Pasture (acres animal units)	Page
435C	3	Dundee silt loam, sloping phase	----	----	----	----	----	2.5	23
435C2	3	Dundee silt loam, eroded sloping phase	----	----	----	----	----	2.5	23
436	1	Dundee very fine sandy loam, nearly level phase	725	90	20		35-65	2.2	21
436B	3	Dundee very fine sandy loam, gently sloping phase	600	60	15		35-65	2.5	23
436B2	3	Dundee very fine sandy loam, eroded gently sloping phase	500	45	15		30-50	2.5	23
436C	3	Dundee very fine sandy loam, sloping phase	----	----	----	----	30-50	2.5	23
436C2	3	Dundee very fine sandy loam, eroded sloping phase	----	----	----	----	30-50	2.5	23
445	1	Dubbs silt loam, nearly level phase	800	90	17		35-55	2.0	21
445B	3	Dubbs silt loam, gently sloping phase	700	65	17		35-55	2.5	23
445B2	3	Dubbs silt loam, eroded gently sloping phase	600	60	17	----	35-55	2.5	23
445C2	3	Dubbs silt loam, eroded sloping phase	----	----	----	----	35-50	2.5	23
446	1	Dubbs very fine sandy loam, nearly level phase	825	90	17	----	35-55	2.0	21
446B	3	Dubbs very fine sandy loam, gently sloping phase	750	65	17	----	35-55	2.5	23
446B2	3	Dubbs very fine sandy loam, eroded gently sloping phase	600	60	17	----	35-50	2.5	23
446C	13	Dubbs very fine sandy loam, sloping phase	----	----	----	----	35-50	2.5	32
446C2	13	Dubbs very fine sandy loam, eroded sloping phase	----	----	----	----	35-50	2.5	32
456	1	Bosket very fine sandy loam, nearly level phase	750	80	----	----	35-55	2.3	21
456B	3	Bosket very fine sandy loam, gently sloping phase	650	55	----	----	35-55	2.6	23
456B2	3	Bosket very fine sandy loam, eroded gently	500	50	----	----	35-50	2.6	23
456C	3	Bosket very fine sandy loam, sloping phase	----	----	----	----	35-50	2.6	23
456C2	3	Bosket very fine sandy loam, eroded sloping phase	----	----	----	----	35-50	2.6	23
460B2	3	Dundee-Bosket soils, eroded gently sloping phases	----	----	----	----	30-50	2.5	23
460C2	3	Dundee-Bosket soils, eroded, sloping phases	----	----	----	----	30-50	2.5	23
460D2	3	Dundee-Bosket soils, eroded strongly sloping phases	----	----	----	----	----	----	23

INDEX—(Cont.)

Estimated average yields of principal crops under good management for the soils of Leflore County.

Soil symbol	Soil group	Soil Name	Cotton (lint lbs. per acre)	Corn hybrid (bu. per acre)	Soybeans (bu. per acre)	Rice (bu. per acre) 1	Oats (bu. per acre)	Pasture (acres animal units)	Page
466	3	Beulah very fine sandy loam, nearly level phase	525	50	---	---	35-50	2.5	23
466B	3	Beulah very fine sandy loam, gently sloping phase	500	45	---	---	35-50	2.6	23
467B	3	Beulah fine sandy loam, gently sloping phase	---	---	---	---	35-50	2.5	23
500	6	Falaya, Ina, and Collins soils	---	---	---	---	---	---	26
524	8	Falaya silty clay loam, nearly level phase	425	70	25	70	40-60	2.0	28
524B	8	Falaya silty clay loam, gently sloping phase	400	65	20	---	40-60	2.0	28
T524	8	Ina silty clay loam, nearly level phase	450	75	25	70	40-60	2.0	28
T524B	8	Ina silty clay loam, nearly level phase	400	70	20	---	35-55	2.0	28
525	6	Falaya silt loam, nearly level phase	500	90	25	70	40-60	2.5	26
525B	6	Falaya silt loam, gently sloping phase	500	80	20		40-60	2.6	26
T525	6	Ina silt loam, nearly level phase	475	90	20	70	40-60	2.0	26
T525B	6	Ina silt loam, gently sloping phase	400	80	20	---	40-60	2.0	26
T526	6	Ina very fine sandy loam, nearly level phase	500	90	25	70	40-60	2.0	26
T526B	6	Ina very fine sandy loam, gently sloping phase	500	75	20		35-55	2.0	26
535	2	Collins silt loam, nearly level phase	700	90	25	65	40-60	2.0	22
T535	2	Hymon silt loam, nearly level phase	600	80	15	---	40-55	2.0	22
T536	2	Hymon very fine sandy loam, nearly level phase	650	85	20	---	40-60	2.3	22
T536B	2	Hymon very fine sandy loam, gently sloping phase	600	80	15	---	40-55	2.0	22
T539+	14	Hymon sand, nearly level overwash phase	---	---	---	---	---	6.0	33
579	14	Sandy alluvial land	---	---	---	---	---	8.0	33
620	6	Waverly soils, local alluvium phase	300	35	20	60		2.5	26
835	1	Pearson silt loam, nearly level phase	650	80	15		40-55	2.2	21
835B	3	Pearson silt loam, gently sloping phase	625	75	15		40-55	2.5	23

[1] Rice yields decline sharply after the first two years of continuous rice.

[2] An animal unit is equivalent to one mature cow, steer or horse, five hogs, or seven sheep or goats.

- - - Not recommended.

Soil Survey Methods and Definitions

Soil Profile: By looking at the sides of pits, road cuts, or ditch banks on your farm all of you have observed that your soils are lying in layers. You probably noticed the difference in the different layers because of their difference in color, texture, structure, organic matter content or some other distinguishing feature or property. These series of layers forming the side of any dug pit are called collectively the **soil profile.** These soil layers or horizons are examined and studied by digging test pits and making borings with a soils auger. The following features are noted for each profile:

1. Color—An indication of the internal drainage.
2. Texture—The percent of sand, silt, and clay.
3. Structure—The arrangement of the soil particles into aggregates.
4. Consistence—Refers to such conditions as friability, plasticity, stickiness, hardness, compactness, and cementation.
5. Porosity—Refers to the degree to which the soil mass is permeated with pores or cavities.
6. Internal drainage—Refers to how easily excess water passes through soil.
7. Runoff—The rate of the movement of surface water off of the soil.
8. Erosion—The amount of the surface layer that has been removed by accelerated erosion.
9. Soil reaction—The sourness or sweetness of the soil.
10. Organic matter content and roots.
11. Relief or lay of the land (percent slope).
12. Parent material—Kind of soil material from which the soil was formed.

Upon the bases of these special features or properties, the soils are grouped into 3 principal classification units as follows:

1. Soil series—A soil series is a group of soils having soil horizons (layers) similar in every respect, except for the texture of the surface layer of soil. Therefore, one soil series may contain two or more surface textures. Alligator, Forestdale, Dundee, and Dubbs are names of important series in the county.

2. Soil types—The soil type is a subdivision of the soil series. Within a soil series are one or more soil types, defined according to the texture of the surface layer of soil. Such names as clay, silty clay, silty clay loam, silt loam and very fine sandy loam are added to the series name to give the complete name of the soil type. For example, Forestdale silty clay loam, Forestdale silt loam, and Forestdale very fine sandy loam are all soil types of the Forestdale series. Except for the textures of the surface layers, they have similar profiles.

3. Soil phase—As used in the survey of Leflore County, soil phase is a subdivision of the various soil types. One soil type may occur on different slopes, may have different degrees of erosion, may have different depths, may have recent deposits of sediments or overwash, or may be subject to flooding by overflow water. These differences are shown by the use of soil phases. For example, Alligator clay level (0 to ½ percent slope) phase and Alligator clay gently sloping (2 to 5 percent slope) phase are two separate phases of the same soil types, Alligator clay. One can readily see that these two phases will present different management problems. Alligator clay, level phase presents problems of slow surface runoff; whereas, Alligator clay, gently sloping phase may have problems of rapid runoff.

The soil surveyors have made a map of Leflore County showing the location of the soil types, phases, and complexes in relation to the roads, houses, streams, lakes and other local cultural and natural features of the landscape.

Note: The material on "Land Capability Classes" has been adapted from USDA Soil Conservation Service Pamphlet No. 128 "The Measure of Our Land" by J. G. Steele.

No. 554

BULLETIN 554 OCTOBER 1957

Sod Seeding

--- Brown Loam Tests

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CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

RECOMMENDATIONS

To avoid part of the hot droughty fall weather, the fall planted crop should not be seeded before late September, preferably October 1-15.

The pasture vegetation should be short.

A complete fertilizer should be applied under the seed at planting.

If a choice of small grains is to be made, oats should be the crop selected. Wheat and rye are satisfactory for forage, however, oats is a satisfactory forage and grain producing crop.

Wild winter peas are the most dependable legume tried for drilling in a permanent pasture sod. Crimson and red clover are satisfactory crops seeded by this method.

Livestock should be removed from the pasture at seeding time and remain off until the pasture is ready to be grazed or after it has been harvested for grain.

Dallis or Bahia grass can be planted in the spring after an oat hay crop without breaking the soil.

Fall plantings of small grains or legumes can be made in meadows following a hay crop in September without seedbed preparation as well as in permanent pasture sods.

Pastures with a thin cover can be interplanted with the desired grass or legume without destroying the existing vegetation.

The crop seeded should be on the recommended list. Sod seeding is too expensive for a crop failure. A fall seeded small grain crop will cost between $15 and $18 per acre depending on the amount of fertilizer used.

Table 1. Forage produced before March 1 by oats, wheat, rye, and barley seeded on upland soil in permanent pasture sod on Brown Loam Branch Station.

	Forage yields in pounds of dry forage per acre			
Rates of seeding in pounds per acre	1954-55	1955-56	1956-57	3-Year average
		OATS		
15	697	692	1915	1101
30	847	886	1716	1150
60	1010	976	2118	1368
90	1148	927	2282	1452
120	1111	853	2213	1392
		WHEAT		
15	915	910	1276	1034
30	895	857	1318	1023
60	880	1275	1504	1220
90	1059	1297	1771	1376
120	806	1292	1644	1247
		RYE		
15	918	1445	2053	1472
30	996	1757	2546	1766
60	1134	2328	2417	1960
90	1303	2353	2646	2101
120	1259	2533	2374	2055
		BARLEY		
15	601			
30	556			
60	586			
90	581			
120	557			

SOD SEEDING IN THE BROWN LOAM

By ROBERT E. COATS

For the past several years extensive tudies have been conducted on the Brown Loam Branch Station with rates and methods of seeding pasture grasses and egumes. With rising costs of labor and materials, a higher producing pasture is necessary for a satisfactory income from he land.

Complete land renovation for fall-seeded crops is expensive because land must be disked or plowed several times before he soil is in suitable seeding conditon. Seeding directly in the sod offers a means of reducing the cost of seeding a winter-growing crop while using the pasture more than one season of the year.

Seeding Rates For Small Grains

Experimental plots were established in he fall of 1954 on Grenada and Calloway ilt loam with moderate erosion and genty sloping phases to determine forage and grain yields of oats, wheat, rye, and barey when seeded at various rates. Seeding ates for each species were 15, 30, 60, 90, nd 120 pounds per acre. Seed was planted in 16-inch drill rows during October.

Fertilizer for the experiments included 50 pounds of ammonium nitrate, the quivalent of 300 pounds of 20 percent uperphosphate and 50 pounds of muriate of potash. These amounts of fertilizer were applied in the drill just underneath he seed at planting time. The plots harvested for forage were top-dressed with mmonium nitrate at per-acre rates of 75 pounds in December and 100 pounds gain about March 1. Plots from which grain yield only was harvested were op-dressed once with 100 pounds of ammonium nitrate per acre on March 1.

Crops used in the experiments were Delta Red 88 oats, Atlas 66 wheat, Abuzzi and Florida Black rye, and Kenbar barley.

One half of three tests, oats, wheat, and rye were clipped for forage yields up to March 1 and left for a grain yield in June. The other half of each test was not clipped but was harvested for grain at maturity to help determine the effect of forage removal upon grain yield.

The treatments were randomized with four replications. Each individual plot consisted of five drill rows spaced 16 inches apart and 18 feet in length.

Forage Yields: The forage yields reported in Table I are exceptionally small for fall and winter growth of sod-seeded small grains, however, this late growth was due primarily to the extremely low rainfall during October for the three years reported. The average date of the first clipping was mid January.

The high seeding rates provided slightly more forage than low rates, however, most of the difference existed in the first harvest. Oats drilled at the rate of 120 pounds produced 1392 pounds of dry forage per acre by March 1, only 20 percent more than was produced by seeding 15 pounds (Table I). The difference was very similar for wheat and rye. The three-year average production of wheat and rye seeded at 120 pounds per acre was 17 and 28 percent more, respectively, than seeding 15 pounds. The three-year average yields of oats, wheat, and rye were higher from seeding 90 pounds per acre than any other seeding rate.

The test with barley was discontinued after the first year because of inferior forage growth and grain production.

Grain Yields: Experiments with cereals for grain production indicate oats are more dependable and higher producing than either wheat or rye. The highest yield was 70.6 bushels of oats per acre produced in 1956. Over a three-year period the low seeding rates (15 and 30 pounds) were not as productive as the higher rates. Seeding 90 pounds of oats averaged 17.2 bushels more grain than seeding 15 pounds, and 12.8 bushels more than planting 30 pounds (table 2).

Wheat produced a satisfactory grain yield one year out of three. Twenty-six bushels per acre in 1957 from 90 pounds of seed was the highest yield produced over a three-year period. The wheat yields during 1955 and 1956 were definitely inferior and below that normally expected from a small grain.

During 1956 Abruzzi rye produced good yields from all rates of seeding, however, this good production existed only one year out of three. Over a three-year period 60 pounds of rye produced 19.5 bushels per acre.

Removing the forage by clipping up to March 1 had a definite depressing effect on grain yields of all three species of small grains tested (Table 2). There

Delta Red 88 oats. Note grass growing between 16-inch drill of oats. Picture taken April 1.

Table 2. Grain yields from oats, wheat, rye, and barley seeded at five rates in a Bermuda-Dallisgrass sod.

Rate of seeding lbs./acre	Grain yields in bushels per acre						3-Yr. av. bushels per acre	
	Clipped			Not clipped				
	1954-55	1955-56	1956-57	1954-55	1955-56	1956-57	Clipped	Not Clipped
				OATS				
15	47.3	21.4	10.3	42.9	40.8	48.4	26.3	44.0
30	47.5	29.8	11.7	39.3	53.4	52.5	29.7	48.4
60	44.8	36.1	11.5	43.6	58.9	63.8	30.8	55.4
90	38.9	31.1	9.6	46.8	70.6	66.3	26.5	61.2
120	41.9	33.0	10.2	41.5	69.9	65.7	28.4	59.0
				WHEAT				
15	9.8	1.9	3.3	11.7	5.2	19.7	5.0	12.2
30	8.5	3.2	3.4	10.4	8.8	21.1	5.0	13.4
60	9.3	4.2	4.0	10.7	13.4	23.2	5.8	15.8
90	9.4	4.4	4.7	10.0	12.0	26.1	6.2	16.0
120	9.5	5.7	4.5	10.3	15.6	24.8	6.6	16.9
				RYE				
15	8.4	14.0	-----	8.1	33.1	10.2	11.2*	17.1
30	8.1	16.3	-----	9.8	33.8	12.1	12.2*	18.6
60	10.3	20.7	-----	12.3	38.4	7.9	15.5*	19.5
90	9.5	17.8	-----	11.6	32.1	10.8	13.7*	18.2
120	10.2	18.1	-----	11.5	36.1	7.4	14.2*	18.3
				BARLEY				
15	3.6	-----	-----	5.6	-----	-----	-----	-----
30	8.7	-----	-----	7.0	-----	-----	-----	-----
60	6.8	-----	-----	14.1	-----	-----	-----	-----
90	9.8	-----	-----	14.4	-----	-----	-----	-----
120	6.8	-----	-----	15.1	-----	-----	-----	-----

*Two year average

vas practically no difference in grain ield from any seeding rate from plots arvested for forage up to March 1. Oats eeded at rates of 15, 30, 60, 90, and 120 ounds per acre and clipped until March produced 40, 38, 44, 57, and 52 percent ess grain, respectively, than comparable reatments that were not clipped. Clipping vheat and rye reduced the grain yield ven more.

It was apparent that cereals sod-seeded vere more severely injured by removing he forage than small grains seeded on prepared seedbed. Seedlings in the arrow slit grew almost straight up and vere subject to more injury than plants vhich had room to spread.

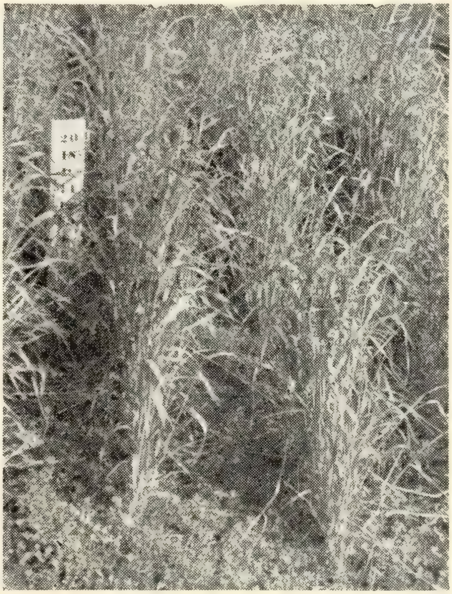
Cross-Seeding Wheat and Ryegrass

In Experiment 2, wheat and ryegrass vere seeded in individual plots at recmmended rates of 120 pounds of wheat nd 25 pounds of ryegrass. The same two rops were also cross-seeded at various ates. Rates of wheat were 30, 60, 90, and 20 pounds of seed per acre. Ryegrass vas seeded at 10, 20, and 25 pounds per cre. The test was fertilized at planting vith 150 pounds of ammonium nitrate, 00 pounds of 20 percent superphosphate nd 50 pounds of muriate of potash per cre applied in the drill. On plots seeded vith wheat in one direction and crosseeded with ryegrass, one-half of the ertilizer was applied under the wheat and he other one-half was drilled under the yegrass. The plots were top-dressed uniormly with 30 pounds of nitrogen per cre from ammonium nitrate in late Deember and again during the latter part f February.

Cross-seeding wheat and ryegrass on he same area was more productive than ither species seeded alone and the disribution of high quality forage extended ver a longer period. It also lessens the langer of losing one crop by disease or evere cold weather.

Over a three-year period wheat drilled lone at 120 pounds per acre produced 297 percent more dry forage at the first clipping than ryegrass seeded alone at 25 pounds per acre. Production from cross-seeded wheat and ryegrass plots was greater than wheat seeded alone (Table 3). Thirty pounds of wheat cross-seeded with 20 pounds of ryegrass was 9 percent more productive than 120 pounds wheat seeded alone and 334 percent more productive than 25 pounds of ryegrass at the first clipping in mid-January. Cross-seeding 125 pounds of wheat with 25 pounds of ryegrass produced 33 percent more dry forage than wheat alone and 426 percent more forage than ryegrass alone. The test was active three years and ryegrass production was the lowest of any treatment each year at the first harvest. High forage yields during the winter months are very important if the pasture is to be grazed.

In total forage production ryegrass ranked above wheat (Table 4). Ryegrass drilled in 16 inch rows at 25 pounds per



Florida black rye seeded at the rate of 90 pounds per acre. Picture taken in February 1957.

acre produced 6 percent more forage than 120 pounds of wheat planted in the same way. Every treatment in which ryegrass and wheat were cross-seeded (at right angles) on the same plots produced from 965 to 1392 more pounds of dry forage than did wheat or ryegrass seeded alone. The increase ranged from 19 percent more for 30 pounds of wheat plus 10 pounds of ryegrass to 28 percent more for higher seeding rates.

Legumes Added in Cross-Seeding

Experiment 3 consisted of oats, wheat, and ryegrass seeded alone and cross-seeded with red clover, crimson clover, and wild winter peas. Ryegrass was also cross-seeded with wheat and oats. The legumes were all cross-seeded at 90-degree angles except three treatments with crimson clover which were seeded at 45-degree angles with oats, wheat, and ryegrass. The seed was drilled in 16-inch rows approximately one-inch above the fertilizer. Three hundred pounds per acre of 14-14-14 were applied under the grass seed at planting. One hundred pounds per acre was applied under the legume seed. Oats and wheat were drilled at rates of 90 pounds per acre. Ryegrass was drilled alone at 20 pounds and cross-seeded with 15 pounds of the other crops. The legumes were cross-seeded as follows: red clover, 10 pounds; crimson clover, 15 pounds; and wild winter peas, 30 pounds.

Including a legume with oats, wheat, or ryegrass had definite advantages over these crops seeded alone. Even though the legumes were slower in initial growth, production during late winter and spring was of a higher quality than where the cereals and ryegrass were seeded alone. Crimson clover matured in early May while wild winter peas were still in a vegetative stage of growth up to June 1.

Table 3. Forage harvested at the first clipping or by January 15 from wheat. ryegrass, and wheat-ryegrass combinations when cross-seeded.

Rate (lbs.) and species seeded	Pounds of dry forage by January 15			3-Year average lbs./acre	Rank
	1954-55	1955-56	1956-57		
120 wheat	579.1	1479.8	821.1	960.0	7
25 ryegrass	327.5	--------	397.2	241.6	9
30 wheat, 10 ryegrass	540.5	1386.4	859.7	928.9	8
30 wheat, 20 ryegrass	592.6	1622.6	933.1	1049.4	6
60 wheat, 10 ryegrass	614.9	1879.8	1017.5	1170.7	2
60 wheat, 20 ryegrass	596.3	1639.2	1039.6	1091.7	5
90 wheat, 10 ryegrass	575.5	1851.6	1014.2	1147.1	4
90 wheat, 20 ryegrass	687.7	1858.0	959.5	1168.4	3
120 wheat, 25 ryegrass	659.4	2043.9	1112.7	1272.0	1

Table 4. Total forage produced for three years from wheat, ryegrass, and a wheat-ryegrass combination.

Rate (lbs.) and species seeded	Yield of dry forage lbs. per acre			3 Year average lbs./acre	Rank
	1954-55	1955-56	1956-57		
120 wheat	3937.6	5296.1	5878.3	5037.3	9
25 ryegrass	5054.1	3579.1	7360.9	5331.3	8
30 wheat, 10 ryegrass	4956.5	5964.0	7302.2	6074.2	6
30 wheat, 20 ryegrass	5324.0	6481.3	7484.6	6429.9	1
60 wheat, 10 ryegrass	5582.4	6044.8	7066.6	6231.2	3
60 wheat, 20 ryegrass	4997.2	6538.2	7745.1	6426.8	2
90 wheat, 10 ryegrass	4879.2	5996.9	7131.3	6002.4	7
90 wheat, 20 ryegrass	4951.5	5837.6	7437.3	6075.4	5
120 wheat 25 ryegrass	5416.7	6357.1	6902.6	6225.4	4

Crimson clover successfully drilled into a thin fescue sod.

Red clover extended the productive period up to near July 1, however, it was slower in early spring production.

Over a two-year period wheat cross-seeded with wild winter peas produced 33 percent more forage than oats or wheat seeded alone (Table 5). Cross-seeding a legume at 45-degree angles in oats, wheat, or ryegrass had no advantages over cross-seeding at 90-degree angles.

Cross-seeding wheat or oats with ryegrass was just as effective for increasing forage yields as including a legume with a small grain.

Cross-seeding a crop at 16 to 20-inch drill spacings has an advantage over closer row spacings. Eight to ten inch rows are just as productive as cross-seeding, but the damage to the permanent pasture is not as great on cross-seeded areas at greater widths.

Planting Dates, Sod Condition

Experiment 4 evaluates five dates of planting and condition of sod cover interplanted. The five seeding dates were, September 1, September 15, October 1, October 15, and November 1. Three sod cover treatments were practiced at each planting date: (1) the sod cover was left 4 to 6 inches high, (2) the permanent pasture grass was clipped short with a mower, and (3) the plots were burned just prior to seeding.

Victorgrain 48-93 oats were drilled in 16-inch rows on each planting date. Three hundred pounds of 13-13-13 fertilizer per acre were applied at planting. The test was top dressed with ammonium nitrate, 75 pounds in December and 100 pounds on March 1. The test was arranged in a randomized complete block design and forage yields were taken through the growing season.

Even though early seeded oats came up and survived, no growth was made until rain came in November. September and October were dry and hazardous growth conditions existed throughout the planting season. The November plantings were just as productive as earlier plantings (Table 6), however, this would not be expected during seasons of normal rainfall.

Clipping the pasture short or burning the dormant vegetation appeared to favor the oats more than leaving the pasture cover 4 to 6 inches high. The small oats appeared to be crowded out in tall vegetation so that the stand was not as good. Annual cool-season grasses such as wild barley appeared in the short grass earlier than in tall sod cover. One year's data shows little adverse effect from burning on the subsequent pasture production. Before the oats were gone, Bermuda and Dallis-grass were up to a good stand. The five leading forage producing treatments were either burned or clipped short (Table 6). More information is needed before definite conclusions are made.

Influence of Legumes

Wild winter peas and white clover were sodded in common and Coastal Bermuda

Table 5. Oats, wheat, and ryegrass seeded alone and cross-seeded with crimson clover, red clover, and wild winter peas.

Treatment	Pounds dry forage per acre				2-Year average	Rank
	1956	Rank	1957	Rank		
Oats	4563	14	5445	15	5004	17
Oats, red clover	4530	15	6279	11	5404	13
Oats, crimson clover	5516	3	6304	7	5910	3
Oats, wild winter peas	4722	12	6770	3	5746	6
Wheat	5249	5	4874	17	5062	16
Wheat, red clover	5248	6	5563	14	5406	12
Wheat, crimson clover	5843	2	5680	13	5762	5
Wheat, wild winter peas	6252	1	7103	1	6678	1
Ryegrass	5334	4	6275	9	5805	4
Ryegrass, red clover	4404	16	6595	5	5500	11
Ryegrass, crimson clover	4400	17	6302	8	5351	14
Ryegrass, wild winter peas	5012	10	6428	6	5720	7
Oats, ryegrass	4936	11	7079	2	6008	2
Wheat, ryegrass	5147	8	6196	10	5672	8
Oats, crimson clover*	5192	7	5427	16	5310	15
Wheat, crimson clover*	5050	9	5991	12	5521	10
Ryegrass, crimson clover*	4624	13	6602	4	5613	9

*Clover seeded at 45-degree angles

Table 6. Dates of planting and sod cover management for oat forage production.

Date of planting and sod cover management	Yield of dry forage lbs./A.		Total	Rank
	1st clipping	2nd clipping		
Sept. 1, cover 4-6" high	1743.9	4090.4	5834.3	12
Sept. 1, cover clipped	1393.3	4638.9	6032.2	9
Sept. 1, cover burned	2310.6	4295.5	6606.1	3
Sept. 15, cover 4-6" high	2163.5	4054.5	6218.0	8
Sept. 15, cover clipped	1878.5	3875.1	5753.6	13
Sept. 15, burned	2179.1	4259.6	6438.7	4
Oct. 1, 4-6" high	1424.6	4300.6	5725.2	14
Oct. 1, clipped	1765.8	3716.3	5482.1	15
Oct. 1, burned	1762.7	4152.0	5914.7	11
Oct. 15, 4-6" high	2003.8	4341.6	6345.4	7
Oct. 15, clipped	1728.3	4228.9	5957.2	10
Oct. 15, burned	1953.7	5059.3	7013.0	2
Nov. 1, 4-6" high	1825.3	4606.4	6431.7	6
Nov. 1, clipped	1753.3	5694.9	7448.2	1
Nov. 1, burned	1834.7	4515.9	6350.6	5

Sod seeded oats being combined in June on the Brown Loam Branch Experiment Station.

sods in Experiment 5 to determine the influence of a legume on (1) length of production period, (2) the effect on the grass after the legume was removed or dead, and (3) the yield of grass and legume. The legumes were sod-seeded in 16-inch rows in October and fertilized with 300 pounds of 20 percent superphosphate and 50 pounds of muriate of potash. The plots were 10 by 15 feet and the treatments were replicated six times. Seeding rates were 30 pounds for wild winter peas and 5 pounds for white clover

Sod seeding was a very satisfactory method of planting wild winter peas in an established permanent pasture sod. Results from this study indicate that white clover can be sod seeded with varying degrees of success and satisfactory uniform stands could not be expected every year.

Interplanting wild winter peas in common and Coastal Bermuda sods extended their productive period by 2 to 2½ month This increase makes it possible to utilize the area for forage production approximately 9 months.

The Bermuda grass, both common and Coastal, was much greener and in a thrifty stage of growth after the peas were gone, indicating the Bermuda grass had benefited from the nitrogen left by the peas. Coastal Bermuda grass sod seeded with wild winter peas produced 7060 pounds of dry forage per acre (Table 7). This was an increase of 4412 pounds over similar plots not seeded with peas. Wild winter peas interplanted in a common Bermuda sod increased the yields from 1058 to 5258 pounds of dry forage per acre. Neither Coastal or common Bermuda sods appeared to be adversely affected by the narrow slits made by the sod-seeding machine.

Seeding Dates, Peas and Clover

Experiments 6 and 7 were established to evaluate five dates of seeding Wild Winter Peas and Crimson Clover. The seeding dates were September 1, September 15, October 1, October 15, and November 1. Seeding rates were 30 pounds for wild winter peas and 20 pounds for crimson clover. One hundred pounds of 47 percent superphosphate and 50 pounds of muriate of potash were applied at planting time. The two tests were arranged in randomized complete block designs with four replications.

Early planted crimson clover was much larger during winter and early spring than late plantings even during a very dry fall. The yields decreased from 5109 pounds of forage per acre for September plantings to 3252 pounds for clover planted on November 1 (Table 8). The difference in growth lasted until the growing season was practically over.

Wild winter peas did not respond to the dates of planting during 1956-57. The peas appeared to suffer from drouth in September and October and yields were somewhat erratic.

Four Legumes Compared

Four legumes, wild winter peas, red, white, and crimson clover were seeded in 16-inch drill rows in a permanent pasture sod for forage production in Experiment 8. One hundred and fifty pounds of 20 per cent superphosphate and 50 pounds of muriate of potash per acre were applied at planting time. The legumes were seeded in a short sod.

Table 7. The influence of sod seeding a legume in either Coastal or common Bermuda sod.

Treatment	Yield of dry forage lbs./Ac. 1954	1955	1956	3 Year av.	2 Year av. 1955 & 1956
COASTAL BERMUDA					
Check (no legume)	1726	3055	2240	2340	2648
Coastal, wild winter peas	2413	7040	7079	5511	7060
Coastal, white clover	1785	3432	2497	2571	2965
COMMON BERMUDA					
Check (no legume)	------	1131	984	705	1058
Common, wild winter peas	-------	5325	5190	3505	5258
Common, white clover	----	1676	1259	978	1468

JOHN DEERE
Grassland Drill

Sod seeding a Bermuda grass pasture with oats on the Brown Loam Branch Experiment Station in October. The narrow seeding feet cause little damage to the permanent sod.

Table 8. Wild winter peas and crimson clover seeded in a permanent pasture sod at five different dates.

Date of seeding	Yield of dry forage pounds per acre	
	Wild winter peas	Crimson clover
September 1	7258.6	5109.5
September 15	3772.0	5109.5
October 1	5669.6	5041.1
October 15	3664.0	4759.5
November 1	7080.9	3552.5

Table 9. Forage production of four legumes seeded in permanent pasture sod.

Species seeded	Yield of dry forage pounds per acre		2 Year average	Rank
	1954-55	1955-56		
Crimson clover	3403.2	4415.2	3909.2	2
White clover	1315.6	2872.1	2093.9	4
Red clover	2371.1	4312.6	3341.9	3
Wild winter peas	3162.7	6520.4	4841.6	1

Wild winter peas and crimson clover came up to a better stand than did red or white clover and were higher in production. Over a two-year period wild winter peas produced 4842 pounds of dry forage per acre (Table 9). Most production from the legumes was in March, April and May. The productive period of red clover extended farther into the summer than the other legumes and the clover came back to a satisfactory stand the following fall. However, it did not come back the second year.

Beef Production

In grazing studies on the Brown Loam Branch Experiment Station, Coastal wheat seeded in a permanent pasture sod provided 76 more days grazing than comparable pastures not sod seeded. Sod seeded Bermuda-Dallis grass pastures were grazed 247 days compared to 171 days for pastures that were not interplanted. The total gains were 271 and 137 pounds of beef per acre, respectively, for sod-seeded and non-sod-seeded pastures.

The per acre cost of sod seeding was slightly over four times greater than pastures that were not interplanted. Counting the fertilizer cost at planting, two top-dressings with ammonium nitrate, seed, and cost of seeding, the per acre cost of sod seeding was $19. This compares to $4.50 for fertilizer and its application on non-sod-seeded plots, or a difference of $14.50 per acre.

In other work on the Brown Loam Branch Station, tests involving beef animals were conducted on sod-seeded pastures and pastures seeded by the conventional method. Coastal wheat was drilled in a fescue sod at the rate of 90 pounds per acre two years out of three. The third-year the wheat was drilled into a Bermuda-Dallis grass pasture. Rates of gain from these pastures and length of grazing seasons were compared to gains made by animals grazing wheat and ryegrass, one of the better grazing combinations, seeded and fertilized by the conventional method.

Over a three-year period wheat and ryegrass provided 179 days of grazing compared to an average of 142 days for steers grazing sod-seeded pastures of wheat and fescue and wheat drilled in a permanent pasture sod. There was essentially no difference in average daily gains from steers grazing the two pastures. The return above cost for steers that grazed wheat and ryegrass seeded on a prepared seedbed was $39.51 compared to $25.34 for steers that were grazing sod seeded wheat and fescue.

Discussion

The sod-seeding method of planting is not confined to cool season growing grasses and legumes. Dallis grass has been very satisfactory when established following an oat hay harvest in May. Satisfactory grazing from millet was obtained by drilling the seed in an oat stubble relatively free of crab grass following a hay harvest in May. Good stands of lespedeza, orchard grass, fescue, bahia grass, and sub clover have been established in short Bermuda grass sod on the Brown Loam Branch Station. Wild winter peas drilled into a Bermuda sod have shown up exceptionally well. Peas planted by this method have been as good and sometimes better than peas seeded by the conventional method or broadcast on top of the sod. Sod seeding is a good practice on land where bogging, trampling, erosion, and water runoff are problems. Sod seeding, with its band placement of fertilizer, is a practice that can be completed with one trip over the pasture with one machine.

Generally, more hazards are encountered in sod seeding than crops planted on a prepared seedbed. The lack of soil moisture during the fall at planting time delays early growth of the seeded crop generally until November. The crop is planted in a viable sod of various types of vegetation with which it must compete for moisture, fertilizer, and sometimes sunlight. Because of unpredictable long dry periods and competition between the seeded crop and permanent pasture vegetation, the fall-seeded crop generally has as much growth when seeded in October as earlier plantings.

Sod seeding has a definite place in Mississippi. However, it is not anticipated that this method of seeding pastures with small grains or legumes will take the place of crops seeded on conventionally prepared land but should supplement it. The crop is seeded approximately one month later than similar crops on a prepared seedbed, consequently, grazing cannot be started until approximately two months or more later than conventionally-planted crops. If a suitable profit is to be realized from grazing, the pasture crop should be large enough to stock during November. Generally, sod-seeded pastures are not productive enough to carry one 500-pound steer per acre through the grazing season even when annual grasses are prevalent between the sod-seeded rows. Experimental data show a high yield of forage but most of it was made after January 15. Sod-seeded crops probably have more of a place for grain, hay, or the introduction of new crops into a sod than for winter grazing.

Experiments indicate that the most dependable small grain for seeding in a permanent sod is oats. This is especially true for grain production. Over a 22-acre field in the spring of 1957 Delta Red oats averaged 40 bushels per acre. Fifty acres of Coastal wheat had a per acre grain yield of 10 bushels. Normally higher yields of wheat are expected. Wheat and rye have produced satisfactory forage yields.

Better results have been obtained from sod seeding wild winter peas than any other legume.

Crops drilled in a permanent pasture sod are not generally as productive as comparable crops planted on a prepared seedbed, however, sod seeding does offer an excellent opportunity of getting extra grazing, hay, or grain from pastures that would otherwise be left idle during the winter months.

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BULLETIN 555 JANUARY 1958

DELTA RED
OATS

Winter Grazing Results South Mississippi, 1951-57

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SUMMARY AND CONCLUSIONS. WINTER GRAZING STUDY

Weather, disease and other factors influenced the returns from winter grazing and the gain varied from year to year, Table 5 and 6. Oats and ryegrass produced more gains per acre at a greated profit per acre than the other crops tested.

Clover planted with oats furnished grazing only when the oats were killed by cold. It cost about $10.00 per acre to seed red clover making this expensive insurance against loss by cold kill.

Clover planted with ryegrass furnished very little grazing. It is questionable whether this practice was profitable since it cost about $5.00 per acre to seed the clover.

It was unprofitable to graze fescue and fescue-white clover. Steers on this combination did not put on enough finish to be acceptable on the market. These steers showed a general unthrifty appearance like animals heavily infested with internal parasites. Fescue would serve best as a pasture for wintering dry cows or steers that are to be finished on summer pasture or in the feed lot.

Wheat and rye produced satisfactory early grazing but both headed out too early in the spring to be used to finish out cattle for the market. These crops serve best with a dairy or cow-and-calf program where an early maturing winter crop is desired so that corn, sorgo or some other summer crop can be grown in rotation.

For winter grazing in South Mississippi oats should be planted on well drained soils and ryegrass should be planted on poorly drained soils.

Winter grazing should not be overgrazed at any time. Winter crops recover slowly from over-grazing and the grazing lost during this period may mean the difference in profit and loss.

The best quality animals available should be used in the winter grazing enterprise. It cost about the same to put a pound of gain on a good animal as it does a poor quality one and the difference in selling price for the good quality animal may mean the difference in profit and loss.

WINTER GRAZING RESULTS, SOUTH MISSISSIPPI, 1951-57

By CLYDE L. BLOUNT

Winter grazing is an intergal part of the pasture program on most successful beef and dairy enterprises in South Mississippi. For a profitable return on investment winter pastures require closer and more intense management than permanent pastures.

Yields vary considerably from year to year as shown in table 1, but the best varieties can be determined by conducting small plot test for several years. Because a crop or variety makes the highest forage yields does not always mean that it will produce the most beef or milk under actual grazing. A crop that produces a uniform supply of grazing during the growing season will likely make more beef or milk than one with an erratic supply. Also some crops are more palatable and easier to digest than others and cattle will utilize these crops more efficiently.

The only way to determine the amount of beef or milk a crop will actually produce is to graze that crop under controlled conditions. With this in mind an experiment was initiated by the South Mississippi Branch Experiment Station in 1951 to compare the grazing results of several crops and combinations of crops.

The experimental area consisted of 24 acres of Greenville fine sandy loam and Blakely sandy loam soil on a "B" slope. This field was divided into 12 paddocks of 2 acres each. With this arrangement 4 crops, or combinations of crops, could be tested with each one replicated 3 times.

The entire field was fertilized annually with 1000 pounds of basic slag, 25 pounds of K_2O and 33 pounds of nitrogen per acre at seeding time in the fall and topdressed with 33 pounds of nitrogen in December and March. The fall application of fertilizer was worked into the seedbed on those crops seeded each year and applied on the surface for perennial crops. The land was turned with a disk plow and pulverized with a disk harrow before each crop was seeded. After seeding the land was cultipacked.

Cattle used in this experiment were grade Hereford steer and heifer calves raised on the Experiment Station or bought at auction. Those raised were valued at the same price as those bought.

All cattle were branded for individual identification, vaccinated and treated for internal and external parasites before the tests began. They had no shelter nor supplemental feed except salt and mineral mixture while on grazing.

The cattle were weighed when put on grazing and every 14 or 28 days during the grazing season. They usually lost weight for about two weeks after being put on grazing but by the end of four weeks they had become adjusted and had regained the weight lost. After this they gained fairly uniformly for the remainder of the season with the highest gains being made in the spring when the

Table 1: Forage yields of available varieties of oats, wheat, rye and ryegrass 1953-1956.

	Yield lbs. dry forage per acre				Ave.
Variety	1953	1954	1955	1956	4 yrs.
Abruzzi rye	3920	2944	6680	4570	4528
Delta Red 88 oats	4450	3087	5400	4020	4239
Camellia Oats	4340	2738	5340	4160	4144
Nortex 107 oats	4250	2910	4960	4070	4047
Chancellor Wheat	4140	2867	6680	3400	4271
Coastal Wheat	5020	2692	4840	3720	4068
Atlas Wheat	4250	2491	5520	3590	3962
Common ryegrass	2890	1697	-------	2080	2222

crops were growing rapidly. During most of the grazing season all animals had very watery feces but this did not seem to affect the rate of gain.

The initial stocking rate was one steer per acre but additional steers were added when there was sufficient forage for another steer for at least 28 days. Results shown are averages of all the cattle on grazing in all three replications.

At the end of the grazing season the cattle were sold through a nearby commission or auction sale.

RESULTS, FIRST SERIES 1951-53

The first series of crops and combination of crops tested were (1) oats with red clover, (2) ryegrass with crimson clover, (3) fescue alone and (4) fescue with white clover. The test was seeded in early October with the following seeding rates; 3½ bushels of Delta Red 88 oats, 15 pounds of Kenland red clover, 20 pounds of common ryegrass, 20 pounds of reseeding crimson clover, 12 pounds of Kentucky 31 fescue, and 5 pounds of Louisiana Giant white clover per acre, respectively.

The average selling price of cattle in this experiment was lower than the purchase price due to a break in the market in 1953 when steers were bought at $24.00 per hundred and sold for $15.50 to $16.00. In other years cattle were sold for about the same or slightly higher price than the purchase price.

Oats-Red Clover

Oats were killed by cold in February of the first year and red clover was grazed the remainder of the season. In other years red clover furnished very little grazing.

Grazing started on oats and red clover

Table 2. Results of winter grazing at South Mississippi Branch Experiment Station, first series of crops 1951-53*

	Oats-red clover	Ryegrass-crimson clover	Fescue alone	Fescue-white clover
Grazing Record (days)				
No. days on grazing	160	131	134	93
Beef Gains (pounds)				
Final wt. per steer	642	650	607	658
Initial wt. per steer	364	376	411	407
Total gain per steer	278	274	196	251
Ave. daily gain per steer	1.90	2.17	1.58	2.62
Total beef gain per acre	375	296	216	251
Cost per Acre (Dollars)				
Land preparation & seeding	8.50	7.83	4.83	6.67
Seed	17.92	8.60	3.37	9.25
Fertilizer	21.83	21.83	21.83	21.83
Total pasture cost per acre	48.15	36.36	29.93	37.61
Cost per Steer (Dollars)				
Purchase price per cwt.**	27.45	27.01	27.49	27.48
Purchase price per steer	99.92	101.56	112.98	111.84
Hauling, commission and veterinary	7.58	7.43	7.50	7.46
Pasture cost per steer	37.62	34.46	23.10	37.61
Total cost per steer	145.12	143.45	143.58	156.91
Financial Return (Dollars)				
Selling price per cwt.**	24.25	24.03	23.11	21.86
Selling price per steer	155.69	156.20	140.28	143.84
Return above cost per steer	10.57	12.75	—3.30	—13.07
Return above cost per acre	14.26	13.77	—3.64	—13.07

*Average of all cattle on grazing in all three replications.

**These prices include one year in 1953 when cattle were bought for 24¢ per pound and sold for 15½ to 16¢ per pound due to a break in the cattle market.

Heifers on ryegrass and crimson clover in 1954.

when the oats were 6 to 8 inches high. The date grazing started varied from year to year depending on the seeding date and the available moisture but the usual starting date was about December 1.

The steers averaged 364 pounds each when put on grazing and gained 278 pounds each in 160 days grazing for an average daily gain of 1.90 pounds per steer per day or a total of 375 pounds gain per acre, Table 2.

Steers cost an average of $27.45 per hundred or $99.92 each. Hauling, commission and veterinary cost $7.58 and pasture $37.62 per steer, for a total cost of $145.12 per steer.

They were sold for an average of $24.25 per hundred or $155.69 per steer for a net profit of $10.57 per steer or $14.26 per acre.

Ryegrass-Crimson Clover

Grazing started on ryegrass and crimson clover when the ryegrass was 4 to 6 inches high. This also varied from year to year but the usual time was about January 15. Dry weather after seeding retarded the growth of ryegrass and crimson clover more than oats because of the shallower root system of the young seedlings. In each of the three years this test was conducted there was a shortage of moisture in the upper surface soil during October and November. As a result the ryegrass and crimson made very little early growth. Once the ryegrass got established it made an abundance of excellent grazing.

Steers averaged 376 pounds when put on grazing. They gained 274 pounds per steer in 131 days grazing or 2.17 pounds per steer per day for a total gain of 296 pounds per acre, Table 2.

The steers cost an average of $27.01 per hundred or $101.56 each. Hauling, commission and veterinary cost $7.43 and pasture $34.46 per steer, for a total cost of $143.45 per steer.

The average selling price was $24.03 per hundred or $156.20 per steer for a net profit of $12.75 per steer or $13.77 per acre.

Fescue Alone

The fescue became well established and was grazed for about 50 days in April and May of the first year. The second and third years grazing started in November when the fescue had begun to make new growth.

The second year the stand of fescue was reduced in spots by dry weather and disease and these spots were over seeded by hand to improve the stand.

The steers averaged 411 pounds when put on grazing. They gained 196 pounds per steer in 134 days grazing or an average gain of 1.58 pounds per steer per day for a total gain of 216 pounds per acre, Table 2.

Very little finish was put on the steers while on grazing and they actually graded little higher at the end of the season than when put on grazing. They did not shed the long hair and as a result looked very rough. No parasite counts were made but they had the general appearance of animals that were heavily infested with parasites.

Steers cost an average of $27.49 per hundred or $112.98 each. Hauling, commission and veterinary cost $7.50 and pasture $23.10 per steer, for a total cost of $143.58 per steer.

They sold for $23.11 per hundred or $140.28 per steer for a net loss of $3.30 per steer or a net loss of $3.64 per acre.

Fescue-White Clover

The first planting of fescue and white clover in the fall of 1950 was a complete failure because of poor stand due to dry weather after planting. Therefore, no grazing was obtained the first year. The test was reseeded the second year and grazed the following spring. This stand of fescue was partially lost as a result of dry weather and disease but the clover reseeded to a good stand. Both the fescue and clover made very poor fall growth and was not grazed until February 20.

The steers weighed 407 pounds when they were put on grazing and they gained 251 pounds in 93 days grazing or 2.62 pounds per steer per day for a total gain of 251 pounds per acre.

Steers cost $27.48 per hundred or $111.84 each. Hauling, commission and veterinary cost $7.46 and pasture $37.61 per steer, for a total cost of $156.91 per steer.

The steers sold for $21.86 per hundred or $143.84 each for a net loss of $13.07 per steer and $13.07 per acre.

RESULTS, SECOND SERIES 1954-1957

After losing money for three years on fescue and fescue-white clover the experiment was revised to include the following crops and combinations of crops: (1) oats alone, (2) wheat alone, (3) rye with ryegrass, and (4) ryegrass with crimson clover.

Fertilizer treatment was the same as the first series of crops except that one year 1000 pounds of dolomite lime and 80 pounds of P_2O_5 were substituted for the 1000 pounds of basic slag.

The test was seeded in early October of each year with the variety and seeding rates and cost of seed. (Table 3)

Weather conditions during the 4 years of this experiment were variable, ranging from wet to dry and warm to cold. In dry periods, especially in October and November, crops made poor growth but in wet seasons they grew very fast and grazing started early. There was very little damage from bogging on the sandy loam soil.

Disease, especially crown or leaf rust, was the most serious hazard and heaviest infestations occurred during warm wet periods in winter and early spring.

Oats

Grazing started when the oats were 6 to 8 inches high. This was usually about December 1.

The steers weighed 469 pounds when put on grazing. They gained 261 pounds per steer in 161 days grazing or 2.01 pounds per steer per day for a total of 437 pounds per acre. Table 4.

Table 3. Variety, seeding rate and average cost of seed for each crop in the second series of crops tested.

Crop	Variety	Seeding rate/acre	Cost/Unit
Oats	Delta Red 88	4 bu.	$ 1.44 bu.
Wheat	*	2 bu.	$ 4.13 bu.
Rye	Abruzzi	2 bu.	$ 3.64 bu.
Ryegrass	Common	20 lbs.	$10.50 cwt.
Crimson Clover	Reseeding	20 lbs.	$24.85 cwt.

*In 1954 the variety of wheat was Coastal, in 1955 Coker-47-27, in 1956 Chancellor and in 1957 Atlas 66.

Table 4. Results of winter grazing at South Mississippi Branch Experiment Station, second series of crops, 1954-57*

	Oats	Wheat	Rye-ryegrass	Ryegrass crimson
Grazing Record (days)				
No. days on grazing	161	115	154	156
No. animal grazing days per acre	216	167	210	217
No. grazing days per steer	130	94	123	122
Beef Gains (pounds)				
Final wt. per steer	730	650	703	735
Initial wt. per steer	469	466	459	486
Total gain per steer	261	184	244	249
Ave. daily gain per steer	2.01	1.96	1.98	2.04
Total beef gain per acre	437	330	410	445
Cost Per Acre (Dollars)				
Land preparation and seeding	8.63	8.63	8.63	8.63
Seed	5.76	8.26	9.38	7.07
Fertilizer	22.29	22.29	22.29	22.29
Total pasture cost per acre	36.67	39.17	40.28	37.97
Cost Per Steer (Dollars)				
Purchase price per cwt.	16.38	16.38	16.38	16.38
Purchase price per steer	76.82	76.33	75.18	79.61
Hauling, commission & veterinary	4.43	4.33	4.45	4.46
Pasture cost per steer	22.24	22.10	23.85	21.60
Total cost per steer	103.49	102.76	103.48	105.67
Financial Return (Dollars)				
Selling price per cwt.	19.32	19.36	19.45	18.90
Selling price per steer	136.82	122.18	132.66	134.77
Return above cost per steer	33.33	19.42	29.18	29.10
Return above cost per acre	55.92	35.19	49.82	51.62

*Average of all the cattle on grazing in all three replications.

The steers cost $16.38 per hundred or $76.82 each when put on grazing. Hauling commission and veterinary cost $4.43, and the pasture $22.24, for a total cost of $103.49 per steer.

The average selling price was $19.32 per hundred or $136.82 per steer for a net profit of $33.33 per steer or $55.92 per acre.

Wheat

Grazing started when the wheat was 6 to 8 inches high. This was usually about December 1.

The steers weighed 466 pounds when put on grazing and gained 184 pounds in 115 days grazing or 1.96 pounds per steer per day for a total gain of 330 pounds per acre, Table 4.

They cost $16.38 per hundred or $76.33 each. Hauling, commission and veterinary cost $4.33 and pasture $22.10 per steer, for a total cost of $102.76 per steer.

The average selling price was $19.36 per hundred or $122.18 per steer for a net profit of $19.42 per steer or $35.19 per acre.

Rye-Ryegrass

The ryegrass made very little fall and winter growth in competition with the rye but after rye headed out in March and the cattle stopped grazing it the ryegrass started to grow and furnished grazing until early May.

Grazing started on the rye-ryegrass when the rye was 6 to 8 inches high. This was usually about December 1.

When put on grazing the steers weighed 459 pounds. They gained 244 pounds in 154 days grazing or 1.98 pounds per steer per day for a total gain of 410 pounds per acre, Table 4.

About 80 to 100 pounds of the gain per acre can be attributed to ryegrass after the rye headed out in March.

The steers cost $16.38 per hundred or $75.18 each. Hauling, commission and veterinary cost $4.45 and pasture $23.85, for a total cost of $103.48 per steer.

The average selling price was $19.45 per hundred or $136.66 per steer for a net profit of $29.18 per steer and $49.82 per acre.

Ryegrass-Crimson Clover

Crimson clover made very little growth in competition with ryegrass and furnished very little grazing throughout the season.

Grazing started when the ryegrass was 4 to 6 inches high. This was about December 1 when there was good moisture following planting.

When put on grazing the steers weighed 486 pounds. They gained 249 pounds in 156 days grazing or 2.04 pounds per steer per day for a total gain of 445 pounds per acre, Table 4.

Steers cost $16.38 per hundred or $79.61 each. Hauling, commission and veterinary cost $4.46 and pasture $21.60 per steer for a total cost of $105.67 per steer.

The average selling price was $18.90 per hundred or $134.77 per steer for a net profit of $29.10 per steer or $51.62 per acre.

Table 5. Results of winter grazing in pounds of gain per acre by years for the first series of crops, 1951-53.

Year	Oats-red clover	Ryegrass-crimson clover	Fescue	Fescue-white clover
1951	251*	326	126	....
1952	453	296	268	208
1953	421	266	254	295
Ave. 3 yrs.	375	296	216	251

*Oats killed by cold in February and only red clover grazed for remainder of season.

Table 6. Results of winter grazing in pounds of gain per acre by years for the second series of crops 1954-57.

Year	Oats	Wheat	Rye-ryegrass	Ryegrass crimson
1954	420	410	341*	423
1955	578	297	547	540
1956	443	350	448	443
1957	309	264	303	373
Ave. 4 years	437	330	410	445

*No ryegrass seeded with the rye in 1954. The rye matured and grazing ended on April 6. In other years ryegrass furnished grazing after rye matured and accounted for 80-100 lbs. gain per acre.

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Weed Control Recommendations

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CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI
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United States Department of Agriculture

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CHEMICALS AND THEIR ABBREVIATIONS

The list of herbicides below is intended only as an aid in obtaining the chemicals. Use of trade names does not imply endorsement of a product by the Mississippi Agricultural Experiment Station, and such naames are given only for herbicides which, at the time of release of this bulletin, are marketed under one trade name only.

Abbreviation	**Trade Name**	**Chemical Name**
2,4-D	Several Mfgs.	2,4-dichlorophenoxyacetic acid
2,4,5-T	Several Mfgs.	2,4,5-trichlorophenoxyacetic acid
sesone	Crag Sesone	sodium 2,4-dichlorophenoxyethyl sulfate
dalapon	Dowpon	2,2-dichloropropionic acid
CIPC	Several Mfgs.	isopropyl N-(3-chlorophenyl) carbamate
monuron	Karmex W	3-(p-chlorophenyl)-1,1-dimethyl urea
diuron	Karmex DL	3-(3,4-dichlorophenyl)-1,1,-dimethyl urea
NPA	Alanap	N-1-naphthyl phthalamic acid
ammonium sulfamate	Ammate	ammonium sulfamate
MH	MH-30 & MH-40	maleic hydrazide

GLOSSARY OF WEEDS

COMMON NAME	BOTANICAL NAME
Bermuda grass	Cynodon dactylon (L.) Pers.
Bitterweed	Helenium tenuifolium Nutt.
Boneset	Eupatorium spp.
Brachiaria	Brachiaria spp.
Bur clover	Medicago hispida Gaertn.
Chickweed	Cerastium spp. Stellaria media (L.) Cyrillo
Cocklebur	Xanthium spp.
Coffee-weed (Indigo)	Sesbania exaltata (Raf.) Rydb. (Sesbania macrocarpa Muhl.)
Crabgrass	Digitaria spp.
Curly Indigo	Aeschynomene virginica L.
Cypress Weed (Texas Cedar)	Eupatorium capillifolium (Lam.)
Dallis grass	Paspalum dilatatum Poir.
Dandelion	Taraxacum officinale Weber
Dock	Rumex crispus L.
Goose-Grass	Eleusine indica (L.) Gaertn.

COMMON NAME	BOTANICAL NAME
Henbit	Lamium amplexicaule L.
Horse-nettle	Solanum Carolinese L.
Johnson grass	Sorghum halepense L.
Milkweed (Spotted Spurge)	Euphorbia spp.
Morning-glory	Ipomoea Purpurea (L.) Roth.
Nutgrass (Coco)	Cyperus rotundus L.
Pigweed	Amaranthus spp.
Plantain	Plantago spp.
Purslane	Portulaca oleracea L.
Ragweed	Ambrosia spp.
Sand bur	Cenchrus tribuloides L.
Sow Thistle	Sonchus spp.
Sida	Sida spp.
Sneezeweed	Helenium nudifolium Nutt
Spur-Weed	Soliva spp.
Tarweed (Sumpweed)	Iva ciliata Willd.
Vetch	Vicia spp.
Watergrass (an annual)	Cyperus spp.
Wild onion	Allium canadense L.
Wild winter pea	Pisum sativum var. arvense L.

CHEMICAL WEED CONTROL RECOMMENDATIONS FOR MISSISSIPPI

Over the centuries, year after year, the farmer has been forced to spend a great part of his time and effort controlling weeds in crops, and yet crop yields and quality have been reduced in most of these years by weeds. Many means have been tried to reduce these losses. Sound management and cultural practices have been developed and proved very effective. Such practices are still being studied critically and modified when necessary to fit special problems. No method should be looked upon as inefficient or out-dated just because it is old.

The control of weeds by the use of chemicals has been extensively studied during the last ten years. Rapid adoption of this practice gives ample proof that it has found a useful place, not only in agriculture, but in other fields in which weeds present a problem.

It should be remembered, however, that herbicides have their limitations. Chemicals are not intended to entirely replace sound management practices, but to supplement them. Also, it is not to be expected that one application of an herbicide will be 100% effective. As with fertilizers, insecticides, and fungicides one application of a chemical is just a part of the over-all program. Neither should it be expected that a herbicide will, in all ways, be better than other means of weed control. It may be more effective, less expensive, or require less labor than other means, but will not necessarily have all three advantages.

While every effort has been made to make this publication as complete as possible, much remains to be decided according to the individual's own conditions. For example, the best weed control in cotton has been obtained by combination of a pre-emergence treatment with post-emergence oil applications and flame cultivation, but many farmers will eliminate one or more of these practices because of weather, costs, lack of necessity or other reasons. Also, the recommended rates of certain herbicides vary with the soil type or other conditions and it is up to the individual to decide which rate best suits his situation.

The recommendations herein are based on the results of studies conducted by State and Federal research workers over several years and are believed to be safe and effective methods of weed control. Certain hazards and precautions are pointed out and an understanding of these common sense rules is necessary to derive full benefit from these recommendations.

Cotton

The problem of improved weed control in cotton is complex. It is impossible to recommend a single practice that will work satisfactorily under all conditions.

The final authority on what method of weed control to use in a particular field is the farm operator. To make this decision he should be thoroughly familiar with his farm in relation to soil type, weeds present, available equipment, monetary resources, capability and capacity of labor resources, and with his own managerial ability.

In addition he should be familiar with the various methods of weed control in relation to cost, effectiveness, and limitations. He should clearly understand whether he wishes to reduce his labor requirements, reduce his cost of weed control or compromise on cost and labor reductions. Further, if he decides to adopt new methods it may be necessary that he retrain his labor forces to perform the new operations.

Pre-emergence herbicides, post-emergence oils, hand-hoeing, cross-cultivation,

Table 1. Relative values of various weed-control practices for specified situations.

	Soil texture																	
	Sands						Sandy loam to friable clay loam						Heavy clays					
Major weed problem Method[1]	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Small seeded annuals[2]	5	1	1	1	6	2	1	1	1	1	6	2	4	4	4	1	6	1
Large seeded annuals[3]	5	4,7	1	4,7	6	1	4	4,7	1	4,7	6	1	5	5	4,7	4,7	6	1
Johnson grass (spotted—up to 5%)	5	3,7	2	4,7	1	3	5	3,7	2	4,7	1	3	5	4,7	4	4,7	1	3
(light to moderate)	5	4,7	1	4,7	5	2	5	3,7	1	4,7	5	2	5	4,7	4	4,7	5	1
(heavy)[4]	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	1	5	5
Nutgrass (spotted)	5	1	1	1	4	1	5	1	1	1	4	1	5	4	4	1	4	1
(light to moderate)	5	2	1	1	5	2	5	2	1	1	5	1	5	4	4	1	5	1
(heavy)	5	5	1	1	5	3	5	5	1	1	5	1	5	5	4	1	5	1
Perennial vines (spotted)	5	4,7	1	4,7	6	1	5	4,7	1	4,7	6	1	5	4,7	4	4,7	6	1
(light to moderate)	5	4,7	1	4,7	6	1	5	4,7	1	4,7	6	1	5	4,7	4	4,7	6	1
(heavy)[4]	5	5	5	5	6	5	5	5	5	5	6	5	5	5	5	5	6	5

[1] A = pre-emergence herbicide.
B = post-emergence oil.
C = cross-cultivation.
D = flame.
E = spot-treatments.
F = hand-hoeing.

1 = one of best methods.
2 = good method.
3 = fair method, frequently of value in special cases.
4 = fair method, occasionally of value in special cases.
5 = not recommended.
6 = insufficient information.
7 = effective on weeds in small, early stages.

[2] Crabgrass, pigweed, Brachiaria, goosegrass, morning glory, etc., all in seedling stages or younger.

[3] Cocklebur, false mallow, etc.

[4] Where no method of control is recommended, fallowing or other general control measures are usually necessary before cotton production is profitable

flame, and spot-treatments can be combined in many different ways according to the situation involved. With-the-row cultivation is generally accepted as desirable in almost all situations at the present. Table 1 is intended to serve as a guide in selecting a practice or combination of practices for a number of common situations. The fact that a particular practice is rated as "A" for a given problem does not necessarily mean that it is the best solution, but rather that it can be used effectively on that problem, either alone, or in combination with other effective practices.

In light weed infestations single practices and simple combinations are effective in reducing labor and costs. In heavy infestations more complex combinations are required for low labor requirements, and in extreme cases to insure that total cost is held to reasonable limits. Making a combination too complex may reduce labor requirements, but can result in unnecessarily high costs.

Figures given in Table 2 represent typical costs (less cost of hoe-labor) of various weed control methods. The assumptions are that applications of flame, post-emergence oil, and cultivation total six in number for the year for hill-dropped cotton and seven for cross-plowed. The oil would be applied twice on hill-dropped cotton and once on cross-plowed. Flame would be applied three times. Benefits will vary widely with the situation and individual abilities. These cost figures, however, coupled with a thorough knowledge of the given siuation, should aid a farm operator in selecting the practice or combination that will best meet his particular needs.

Results to date indicate that the recommended use of herbicides, flame, and cross-plowing do not greatly affect yields. At present the average of all results indicate that there may be a slight increase in yield due to use of these recently recommended practices. If such an increase is a real one it is probably due to better control of weeds. The prospective user of herbicides is cautioned that these studies are still in progress and that the only conclusion reached thus far in respect to yields is that the advantages of the practices recommended here substantially outweigh the disadvantages and hazards.

In relation to cost and labor the only conclusions reached are that the recommended practices will greatly reduce labor requirements, lessen the danger of extreme weed infestations, and tend to stabilize costs of weed control at relatively low levels. In seasons of light weed infestations the use of some of the recommended practices can cost more than hand-hoeing and conventional cultivation. For more details on costs, labor requirements, and yield effects see Mississippi Agricultural Experiment Station Circulars 179 and 203.

Land Preparation

A firm settled seedbed is important in obtaining a stand of cotton. Preparation of a good seedbed is equally important for obtaining best results with post-emergence chemicals and flaming that follow

Table 2. Typical basic cost of 16 methods of weed control (exclusive of hoe-labor) in dollars per acre.[1]

Weed control methods	Cotton hill-dropped		Cotton drilled and cross-plowed	
	No flame	Flame	No flame	Flame
No chemical treatment	$3.00[2]	$ 5.85	$ 6.62	$ 9.47
Pre-emergence	5.83	8.68	9.45	12.30
Post-emergence oil	6.40	9.25	8.57	11.42
Pre-- and post-emergence	9.23	12.08	11.40	14.25

[1] Based on performance of 4-row tractors in relatively large, level fields. Includes cost of chemicals, applicative machinery and cultivation.

[2] Six cultivations at $0.50 each = $3.00.

pre-emergence treatment. Fertilizers should be applied in such a way as not to lose moisture from the firm seedbed. The land should be bedded at least two to three weeks in advance of planting to increase the chances of adequate moisture for good germination of the seed. When the seedbed cannot be prepared early, it should be firmed with a cultipacker, drag or rollers.

There is no substitute for a good, uniform, well drained seedbed for the best weed control program of any kind. There should be enough loose soil left on the seedbed after the beds have been raked or dragged off to adequately cover the seed. If the planter is equipped with runner wings, it may not be necessary to drag off the row. Uniformity in height and width of seedbeds is necessary for post-emergence oils and flaming.

All fields should have adequate drainage for the operation of equipment.

Pre-Emergence Treatment

Equipment: Pre-emergence treatments may be made with equipment similar to that used in applying liquid insecticides. Commercial machines are available which apply herbicides satisfactorily. Basically, the equipment consists of a tractor shaft-driven pump, strainers, pressure regulator, gauge, fan-type nozzles, tank for the herbicide, and suitable hose for connections. Most 1-, 2-, and 4-row planters can be modified to apply the pre-emergence herbicides correctly.

Planting: Following proper seedbeed preparation, hill-drop the cotton seed 10 to 22 inches apart at a rate to give 4 to 7 stalks per hill. The number of seed to plant per hill will vary according to the germination percentage. Normally, 6 to 12 seed per hill will be required. If hill-dropping cannot be used then drill plant the cotton and hand thin at a later date.

Cross-plowing cotton for weed control has been practiced for a number of years on land where erosion is not a problem. Chemical treatment can be used in combination with cross-plowing. If pre-emergence treatments are to be used the seed should be drilled at a high rate (60-90 lbs. per acre). The chemical should be applied at the same rate and manner as described under "Herbicides to Use."

Numerous tests have shown no advantage in pre-emergence control obtained

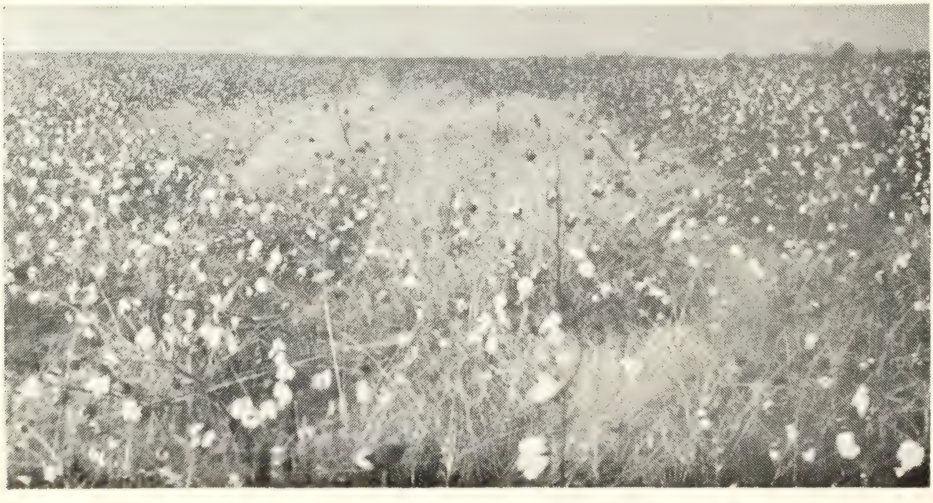

Figure 1. Poor drainage results in poor stands, expensive weed control, reduced yields, and lower grades with mechanical harvesting.

Table 3. Rates of herbicides for various types of soil.

Herbicide	Soil Texture	Lbs./A on 12-inch band*
CIPC	Medium sandy loams	1.2 to 1.8
CIPC	Very fine sandy loams	1.8 to 2.4
CIPC	Silt loams	2.1 to 2.7
CIPC	Clay loams	2.4 to 3.6
Diuron	Medium sandy loams	.15 to .22
Diuron	Very fine sandy loams	.22 to .30
Diuron	Silt loams	.30 to .40
Diuron	Clay loams	.40 to .75

*Applies only where rows are 40 inches wide.

by using a wide roller instead of the regular planter press wheel. However, if post emergence treatments are to follow pre-emergence applications a wide flat press wheel will give a better shaped seedbed for the later operations and should be used.

Placement of Herbicides: The chemical is sprayed on the soil behind the planter press wheel at the time of planting. Cotton seed should be planted at least one-half inch deep and well covered with soil. The nozzle is located to the rear of the planter press wheel or extra roller and at the proper position to spray completely a 12-inch band centered on the drill. The pre-emergence application is made in the same operation with planting to insure proper placement of the herbicide. It is most difficult to get correct placement of the chemical when applied in a separate operation.

Herbicides to Use: CIPC or diuron is recommended for use on sandy loam to clay loam soils for control of most small-seeded annual weeds. No pre-emergence herbicide is recommended for extremely sandy soils, for heavy clay soils such as Sharkey, Houston, etc., or for the control of perennial weeds. Should both perennial and annual weeds occur in appreciable numbers in the same field, it is suggested that a pre-emergence herbicide be used only at a lower rate with a view of reducing hand-labor requirements and providing some insurance against prolonged rainy periods.

Rates of Herbicides: Recommended rates for each herbicide are presented in Table 3. Within a given soil texture the lower side of the rate-range should be used on soils low in organic matter or general fertility. In fields consisting of more than one soil type the field should either be divided into smaller fields of the same type of soil; or if the area of the secondary soil type or types is insignificant in size, the rate should be selected in accordance with the major soil type.

Replanting: Adverse weather sometimes make it necessary to replant cotton, including that which has received pre-emergence treatment. This failure to obtain or maintain proper stands after investing in a herbicide is an important limitation to the use of pre-emergence chemicals.

If replanting is necessary and the row is free of weeds, replant in the previously treated band without further seedbed preparation. In cases where compactness of the soil makes this impractical, or the row is grassy, prepare the soil and replant in the conventional manner. Do not hip-up to replant.

No control of weeds by the chemical can be expected following re-preparation of the seedbed. Retreatment with CIPC following thorough seedbed preparation does not present a hazard to the crop and may be done if chemical control of the weeds is deemed necessary. Where diuron is used and replanting is necessary, retreatment should not be done.

Duration of Effectiveness: Under most conditions CIPC or diuron has given control of the troublesome annual grasses crabgrass and Brachiaria, and satisfactory control of pigweed, morning-glory and certain other annuals. These materials do not control perennial weeds such as nutgrass, Johnson grass, deep-rooted vines, etc. Pre-emergence treatment can usually be expected to control weeds in the treated band from 4 to 6 weeks. When the first weeds begin to appear in the previously treated band, post-emergence treatments with herbicidal oil should be applied. Weeds that escape pre-emergence control should be given post-emergence treatment before they develop beyond the seedling stage.

Post-Emergence Treatments

Weeds in the untreated middles should be controlled by cultivation without throwing any fresh soil or clods into the treated band, at least until after all chemical or flame operations have ceased or have become ineffective. Soil or clods thrown into the treated area will contain weed seeds and the drill area will be roughened so that effectiveness of post-emergence oil or flame is reduced. See the equipment section for details of these operations.

For controlling weeds in the drill area, it is recommended that one to three applications of a herbicidal oil be used, followed by flame cultivation or regular cultivation. Where the cotton was drilled at a heavy rate, oil can also be used just prior to cross-cultivation or cross-cultivation can be used without application of the oil. In other cases it may be more practical to use hoeing and flame cultivation only.

Herbicidal Oils: The oil used should be one sold by a reliable concern as a herbicidal oil for cotton. Three commercially available oils[1] have performed satisfactorily for several years in field tests. These oils are petroleum products containing no added fortifying agents. Certain pre-emergence chemicals have been used experimentally to control weeds in cotton by post-emergence applications, but these treatments are not currently recommended. These recommendations are for the use of non-fortified oils only.

Normally two nozzles per row are used (see equipment section). One nozzle should be used on each side of the row and each nozzle should be 5 inches from the drill center. The two nozzles should be spaced and directed so as to prevent the two spray patterns from meeting head-on, as this might cause an objectionable deflection of the spray. Nozzles should be set so that the spray fan is horizontal and strikes the young cotton stem no higher than **1 inch from the ground** level and gives adequate coverage of the weeds. The nozzles should be set so that they are 1 inch or less above the soil. A slight downward tilt may be given to the nozzles to increase the ease of keeping oil off the seed leaves of the cotton. If the downward tilt is excessive most of the oil will be undesirably concentrated on the ground at the base of the cotton stems and the band treated will be too narrow. The oil should settle in the 8- to 10-inch band centering on the drill.

The importance of keeping the oil on the lowest inch of the cotton stem cannot be over-stressed. Oil applied high on the stem, on the bud, or on the leaves will injure or kill young cotton plants.

When the cotton seedlings have been out of the soil for 7 to 10 days (at least 3 inches tall) the first application of herbicidal oil may be made, if needed. The first oil application will be needed when weeds make their first appearance in the treated drill area. If the cotton has been out of the soil for less than 3 weeks, from 5 to 7 gallons per acre of oil may be applied for the first application, depending on the amount of weed growth. After the cotton has been out of the ground for

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[1] Cities Service, No-Weed Oil No. 1; Esso 38; and Lion Herbicidal Oil No. 1.

3 weeks, or after the first application, no more than 5 gallons per acre should be applied at any one time.

Repeat applications of oil as needed, except that they should be at least 5 days apart, and a total of no more than three applications should be made. Oil should not be applied after the bark begins to form or small bark cracks begin to appear at the base of the stem. Moreover, if there is any appreciable injury noticeable from previous oilings, more oil should not be applied until injury has healed.

More than three applications of oil, including applications after the formation of true bark, have been made without cotton injury. The risk of injury, however, is much greater than when three or fewer oilings are made prior to bark formation, and none after this time.

By the time the second or third application of oil is made, most of the weed seed near enough to the soil surface will have germinated and have been killed. This frequently means that no further weed control is needed in the cotton drill, provided no soil containing viable weed seed is thrown into the drill area during middle cultivation. Under such a circumstance, further weed control may consist of simply cultivating the middles while using a drill-protecting shield. If further weed control is needed in the drill area, it is recommended that flame cultivation be used for the remainder of the program as this will do a good job of safely controlling the weeds. It will also maintain the undisturbed drill area, and thus tend to prolong weed control.

Recommendations given for post-emergence oils will work if the oils are applied correctly. In the farm operator's first attempt at using herbicidal oils, he should not deviate from the recommendations. As experience is gained, the alert operator will see ways to increase the efficiency of oils for a particular condition by making slight changes in methods of application. Such changes should not be attempted until the operator thoroughly understands the principles involved in the control of weeds with oil without causing injury to the crop. When any such change is needed, it is required only because of a failure to carry out successfully the basic recommendations. This does not necessarily mean that the operator is at fault, but may mean that circumstances beyond his control have affected the results of his work.

Conventional Cultivation: This long-used practice needs little explanation. It simply consists of the use of sweeps to throw soil into the drill area for the purpose of smothering young weeds. It **should not** be used if the weeds are still under control by previous chemical or flame treatments nor if the use of further post-emergence oil or flame is planned. If, however, neither oil nor flame can be used and a weed problem is beginning to develop in the drill area "dirting" can be used very effectively to reduce and delay the weed problem. Failure to "dirt" or excessive delay in its use when it is needed, is as detrimental to a successful program as is "dirting" when it is not needed. Care should be taken to avoid deep cultivation (which will prune the roots of the cotton), and it should be used no more often than necessary for weed control. This practice will, of course, eliminate the residual benefits from previous treatments.

Cross-Plowing: Cross-plowing is that practice where the cotton is drilled at a heavy rate and cultivated both with and at right angles to the row. This cross-plowing thins the cotton mechanically and plows a large part of what normally would be the drill area. Its use is generally restricted to soils lighter than clays and to relatively level fields. Only good, unbroken stands of cotton prior to cultivation are acceptable. The number of cotton plants left is determined by the width of the space between the sweeps, disk-hillers or other tools used in the cross-cultivation. Final stands of 6 to 18 stalks per hill are satisfactory where the cross-cultivation is at the standard row width (38-42-inch centers). Because second and later cross-plowings will be likely to plow out additional plants, the first crossing should leave a few more plants than are needed for the final stand.

Cross-plowing can be very effectively combined with pre- or post-emergence herbicides. In such cases cultivation should be accomplished in a manner to keep the treated area as free of loose soil as possible. Shield sweeps, disk-hillers, and other similar implements are recommended for this practice. If post-emergence oil is used it must be applied **before** the first cross-plowing. As a general rule there will be time for only one oil application with cross-plowing. Flame cultivation is an excellent tool to use in conjunction with cross-cultivation.

Flaming: Flame cultivation has been used as terminal treatments following pre-emergence and post-emergence chemical treatments. Flame has also been used in conjunction with cross-plowed cotton to obtain substantial savings in weed control cost.

Flaming is recommended with the flat-type burner which uses butane, propane, or a mixture of the two fuels.

Flame treatments may be started when the stems are at least 3/16-inch in diameter. If weeds are controlled in the stages of growth prior to the use of flame, control is fairly simple. Should the weeds get out of hand, hand hoeing is the most practical method to clean the crop.

Proper use of the flame cultivator, however, will greatly reduce the chopping cost per acre and while some damage to the crop will result under extremely grassy conditions, this can be kept at a minimum by the understanding of flame cultivation.

If the farmer attempts to obtain a complete kill of thick stands of grasses, subsequent flamings will ignite this grass and damage will result from this fire rather than from the flame of the burner. It is desirable, therefore, to remove heavy growths through a series of burnings, usually from two to three, rather than by one or two extremely heavy applications of flame.

Figure 6 shows the setting of the flat type burners. These are operated at a pressure of from 45 to 55 pounds per square inch. Speed of the tractor will range from 2.5 to 4 mph; the size of the weeds will determine the speed to use. The burner is set at an angle of approximately 45 degrees with the ground, with the opening of the burner from 8 to 10 inches back from the drill and at a height of 8 to 10 inches from the ground. The flame should strike the ground from 2 to 3 inches on the burner side of the drill.

It is suggested that any farmer using flame go to the field with the machine either late in the afternoon or at night when the flame pattern can be observed. He will then have a better conception of the flame behavior and accordingly can make more accurate settings of his machine.

Flame cultivation should not be considered as the complete answer, but when properly used it is efficient and will reduce greatly the cost of weed control.

For more detailed information concerning flaming, see Mississippi Agricultural Experiment Station Bulletin 545.

Weeds Controlled by Post-Emergence Treatments: Combinations of post-emergence oils and flaming will control most small-seeded annual weeds such as crabgrass, Brachiaria, water grasses, pigweed, and annual morning-glory. Nutgrass, perennial vines, annual vines, cocklebur, Sida, milkweed, and other similar plants may be controlled if they are sprayed or flamed when small enough to get complete coverage of the above-ground parts. As a general rule, Johnson grass is not satisfactorily controlled by pre-emergence, post-emergence oil or flame treatment.

All weeds are controlled most effectively when they are less than 2 inches high. After they get larger some of them become resistant to the oil and complete coverage becomes impossible from a practical standpoint. The ideal time to apply either oil or flame is when the weeds are about one-half inch high. Nothing is gained and much may be lost by waiting until more weeds germinate.

Both oil and flame are best suited for keeping a clean field clean, and neither is particularly effective in cleaning up an extremely rank growth of weeds. Usually some non-susceptible weeds will be present in any field, and a few susceptible ones will usually survive these treatments. These weeds should be removed by spot hoeing. Normally only a very few hours per acre will be required to do this, and it can be done more or less at the convenience of the farm operator.

Cultivation and cross-cultivation control all weeds in the cultivated zone at least temporarily and, by smothering, will control many small weeds in the drill area.

Corn

The weed problems in corn may be broadly classified into early-season and late-season ones. Crabgrass, Brachiaria, goosegrass, pigweed, and certain other small-seeded weeds usually constitute the early-season problem. Morning-glory and cocklebur may develop after the last cultivation and cause lodging and lower mechanical picker efficiency. Two kinds of treatments for weed control are recommended for the above problem.

Pre-Emergence Treatment

Where annual weeds present an early-season problem DNBP and certain salts of this material are recommended for pre-emergence control. The herbicide is applied as a band treatment in the same operation with planting in the same manner as recommended for pre-emergence treatments on cotton. Rates of application should be 1½ to 2½ pounds per acre on a 12-inch band basis. This material is not recommended for extremely sandy or heavy clay soils. DNBP does not present as serious a drift hazard as 2,4-D but is poisonous to warm-blooded animals and therefore instructions on the manufacturer's label should be read and strictly observed.

Post-Emergence Treatment

In cases where a weed problem develops, flame can be used alone or in conjunction with conventional sweeps with each cultivation. Timing of flaming treatment is especially important, since most effective control is obtained before weeds reach a height of three or four inches In heavily infested areas frequent flame applications are essential for best results.

Flame cultivation with high-clearance rigs has appeared practical for late-season weed control in corn, since heavy growths of weeds often occur following late-season rains. High-clearance machines permit weed control to be extended beyond the normal lay-by date. Effective late-season control is an important factor in harvesting efficiency with mechanical pickers. Refer to Mississippi Agricultural Experiment Station Bulletin 545 for specific details of flame cultivation.

Broadleaf weeds such as ragweed, coffee-weed, cocklebur, and morning-glory may be controlled readily in corn with 2,4-D (amine formulation). If the weeds occur before the corn is 12 inches tall an overall broadcast spray may be made at the rate of 1/3 to 1/2 pound per acre using 10 to 20 gallons of water. The overall treatment, however, may cause some stalk brittleness, injure corn brace roots, and does not control grassy weeds.

Where broadleaf weeds are present at and after lay-by, 2,4-D (Amine formulation) should be applied to give good coverage of the tops of the weeds. Two drop nozzles per middle can be employed to give good coverage of the weeds in the middles and the drill avoiding, insofar as possible, spraying the corn leaves and stalks except for a few inches at the ground level. An application rate of 1/2 pound per acre on a broadcast basis is recommended. If only band treatments are necessary the amount of 2,4-D is reduced in proportion to the area actually sprayed.

The post-emergence treatments may be made on corn growing on any soil type. The cost of controlling tall growing broadleaf weeds in corn with 2,4-D is frequently more than off-set by improved picker efficiency alone. Corn should not be treated with 2,4-D at the silking and tasselling stage but the directional spray can be applied safely at all other stages.

Permanent Pastures

Until recently the mower has been the only means the farmer had of keeping weeds in pastures under control, but now 2,4-D can be safely employed to control most broadleaf weeds which infest permanent pastures. If done according to recommendations, mowing will give fair control of weeds, but in many cases the practice is not closely adhered to or is restricted because of terrain features.

Studies conducted since 1950 indicate that the following post-emergence recommendations are sound and worthy of wide employment on permanent pastures infested with broadleaf weeds.

Use 2/3 to 1 pound of 2,4-D per acre in 10 to 20 gallons water as a broadcast spray application. First treatment should be made in early summer (April-May), followed by a retreatment in mid-summer (July), if needed.

Pasture grasses and legumes should be well established and the weeds emerged but still small when treatment is made. It is hazardous to treat seedling grasses or legumes. Treatments should not be made during long droughty periods because stunted or slowly growing weeds are somewhat resistant to the 2,4-D spray.

Permanent pastures heavily infested with bitterweed and near cotton fields can be safely sprayed in February, March or April before the cotton comes up. Apply 1 pound of 2,4-D per acre in 10-20 gallons water as a broadcast pre-emergence treatment for the control of bitterweed. Bermuda grass, Dallis grass, fescue, Bahia, Coastal Bermuda, Johnson grass, white and Ladino clover, lespedeza and black medic are not injured to any significant extent by the treatment. Plant growth may be retarded for a short period in these plants but they quickly recover. Pasture species severely injured by 2,4-D are crimson clover, red clover, hop clover, vetch, and wild winter peas.

Excellent control of most broadleaf weeds such as bitterweed, tarweed, croton, cocklebur, sumpweed, ragweed, boneset and sneezeweed can be expected.

For control of wild onion, garlic, and cypress weed refer to Specific Weeds.

Observe all precautions on the label of the 2,4-D container and exercise extreme care to prevent drift of spray to growing cotton and other susceptible crop or ornamental plants.

Rice[2]

Coffee-weed and curly indigo present the main weed problem in rice. These weeds can be controlled in rice fields with 2,4-D, 2,4,5-T, 2-(2,4,5-TP), or MCPA. Coffee-weed is controlled equally well with either of the four herbicides, however, 2,4,5-T is the best one for control of curly indigo.

These materials should not be applied when it is windy nor when a breeze is blowing toward a nearby field where cotton or other sensitive crops are being grown. Soybean, sweetpotato, and many of the common vegetables are sensitive but cotton is particularly sensitive to these materials. Field research over a period of several years has indicated that 2,4,5-T (amine formulation) and MCP are not as toxic to cotton as 2,4-D at equivalent rates. This should not be taken to mean that these herbicides will not injure cotton, but rather that injury to cotton from drift of 2,4,5-T and MCP is usually not as severe as that caused by 2,4-D.

Certain esters of these chemicals are volatile and vapors will move for great distances. Several commercial concerns now formulate **low volatile esters** which will give the desired weed control without a vapor hazard. Because of the risk involved in using the volatile esters of these chemicals, the following recommendations apply only to spray applications of the **amine and low volatile ester** formulations.

Time to Spray: Rice seedlings are very sensitive to 2,4-D and similar materials. A substantial reduction in yield may occur if herbicides are applied before rice is 5 to 6 weeks old or by treating at or after the boot stage. A slight reduction in yield may result from treatment during the joint stage. The least injury (best time to treat) to rice from herbicide treatment is encountered during the late tillering stage (8 to 10 weeks old).

Rates of Chemicals: Apply 2,4-D or 2,4,5-T at the rate of 3/4 to 1½ pounds (acid equivalent) per acre in 5 to 10 gallons of water if ground equipment is being used. However, 2 to 5 gallons of water has been adequate where aircraft was used. Avoid treating before rice is five to six weeks old unless a serious weed problem develops. If the weed infestation demands an early application, then, ½ pound per acre may be used as early as three weeks after emergence of the rice.

Apply MCPA or 2-(2,4,5-TP) at the rate of 1 to 1½ pounds (acid equvalent) per acre in the same volume of water suggested above for 2,4-D. A 3/4 pound rate may be used three weeks after emergence if necessary, but the high rate should be used in later applications.

The addition of a wetting agent[3] to the chemical solution will increase the effectiveness of these chemicals.

Small Grains

Dock and other weeds may be controlled by treatment with 2,4-D in the early spring. Dock is most sensitive to 2,4-D when it is growing actively. During periods of retarded growth or as the plant nears maturity, the compound does not give adequate control. Because the herbicide is most effective during warm, sunny weather, application should be made during such a period. The time for spring application is when the dock resumes growth but prior to development of the stalks and seed heads.

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[2] Credit for the Rice Section is given to:
R. J. Smith, Agronomist,
Crops Protection Research Branch, ARS, USDA, Stuttgart, Arkansas.

[3] Good results have been obtained by using Dreft, Tide, etc., at a rate of one tablespoonful per 10 gallons of spray.

Application of 2,4-D to dock in small grains should be made after the crop plants are well tillered but before the cereal stems have elongated. In most seasons the period from February 1 to March 15 could be considered a safe time to treat cereals with 2,4-D for dock control.

The amine form of 2,4-D, which is usually formulated as 4 pounds of the active 2,4-D per gallon, should be applied at the rate of 3/4 to 1 pound active material per acre. Ten to 20 gallons of water containing the 2,4-D will spray one acre satisfactorily with ground equipment. Good success has been obtained also from aerial applications at lower volumes.

One application of 2,4-D made properly will give a high percentage control of dock. Because there are numerous dormant seeds in the soil more than one year is required to eradicate dock from infested areas. Applications of the amine form of 2,4-D to control dock causes little damage to established stands of white and Ladino clovers. The clovers show curling and some stunting following treatment but can be expected to recover by the end of the growing season. Pasture grasses are quite tolerant to this form of 2,4-D. Severe damage, however, can be expected when this amount of 2,4-D is used on young legume and grass seedlings. It is safe to graze cereals sprayed with 2,4-D.

Wild winter peas and vetch in small grains can be controlled with the same rate of 2,4-D as used for dock, but better control of these two weeds can be obtained with 2,4,5-T at the rate of 3/4 to 1 pound (acid equivalent) per acre. This chemical is more expensive than 2,4-D and will not control dock as well as 2,4-D and is also more injurious to legumes.

Soybeans

Since soybeans are planted in late spring or early summer, shallow, pre-planting cultivation may be used as a means of controlling one or more crops of early weeds. Very shallow disking, plowing, use of harrows or rotary hoes or tillers should destroy the weeds and form a shallow mulch.

Where annual weeds such as crabgrass, pigweed, and annual morning-glory present early-season weed problems the use of herbicides may be warranted. NPA has given good results for two years as a pre-emergence herbicide on soybeans. Until further data is obtained it is suggested for trial use only.

Rates for various soil types are presented in Table 4. Seedbed preparation and application of sprays should be done in the same manner as recommended for cotton. The seed should be covered at least one-inch deep. The pre-emergence treatment is not recommended for use on extremely sandy soils or on heavy clay soils such as Sharkey, Houston, etc.

Table 4. Rates of NPA for various types of soil.

Soil texture	Lb./A on 12-inch band*
Medium sandy loams	.60
Very fine sandy loams	.90
Silt loams	1.20
Clay loams	1.80

*Applies only where rows are 40 inches wide.

A single directional spraying with one of the herbicidal oils recommended for cotton has given good control of most young annual weeds in soybeans when applied correctly and at the proper time. An oil treatment of 5 gallons per acre when the soybeans are from 12 to 16 days past emergence and applied exactly as prescribed for use in cotton, is recommended where no pre-emergence chemical is used and an early annual weed problem exists. Under no conditions should the rate of 5 gallons per acre be exceeded.

Miscellaneous Crops

Sorghum

No satisfactory pre-emergence herbicide has been found for use in sorghum but post-emergence applications of the amine formulation of 2,4-D, employed in the manner described for corn, can be used to control the common broadleaf weeds that occur in this crop. An application rate of 1/3 pound per acre is suggested at or after the last cultivation.

Flame cultivation may be used in sorghum in a manner similar to that described for corn. The first treatment should be made when the sorghum is about 8 inches high. It is recommended that the equipment be adjusted as to burner angle, pressure and speed and that two to four rows be flamed the day before it is planned to flame the entire crop. The effects of this trial will be evident in a short time and any necessary corrections in adjustments can be made.

Strawberry

Annual grasses and broadleaf weeds may be controlled satisfactorily in strawberries by applying sprays of 2,4-DES. Treatments must be applied before the weeds germinate, but newly transplanted strawberries should have begun to grow before the treatments are made. If weeds are present they should be removed by hoeing or clean cultivation before making a treatment. An application rate of 3 pounds per acre in 40 gallons of water gives satisfactory control of annual weeds under most conditions. Retreatments should be made at 3 to 4 week intervals as needed, but all growing weeds should be removed beforehand. Poor results can be expected if the weather is dry, therefore irrigation by overhead sprinklers following treatment is advisable if such equipment is available.

Vine Crops

Studies in Mississippi of NPA as an herbicide for watermelons, cantaloupes and cucumbers have confirmed more extensive experimentation in other regions in that the pre-emergence application of NPA or its sodium salt at a dosage of 3 pounds per acre in 40 gallons of water appears promising for controlling annual weeds in these crops. Broadcast spray treatments are made after planting but before emergence of the crop. Like other pre-emergence herbicides, NPA cannot be expected to give good weed control if prolonged dry weather follows application or if the land is cloddy and rough.

Lima Beans, Snap Beans, Field Peas

Commercial growers of these crops who have annual weed problems may wish to use the pre-emergence herbicide DNBP or its salts. These crops have exhibited good tolerance of this herbicide. Application of 6-8 pounds per acre on a broadcast basis in 20 to 40 gallons of water usually gives good control of annual weeds for about 3 to 5 weeks with a concurrent reduction in hand hoeing requirements. If band treatments are employed the rate should be reduced proportionally. The herbicide should not be used when temperatures above 90°F. are expected because some vapor injury to the leaves may occur.

Home Garden Crops

Because of the difficulty in application of exact rates without mechanical equipment and also because many herbicides are not sold in small packages, herbicides are not recommended for use in garden crops. No chemical should be applied to a food crop unless the label specifically mentions that crop, indicating that the chemical is safe to use. Fence rows and weeds not growing too close to crop plants may be sprayed with a naphtha type oil, but contact of the oil with crops must be avoided. Small areas of nutgrass or Johnson grass may be safely fumigated with methyl bromide as described under the topic "Nutgrass".

Lawn Weeds[4]

Any chemical weed control measures in lawn or turf should be accompanied by proper lawn management practices. Proper fertilization, irrigation, drainage, and mowing are essential to the success of any lawn improvement program.

Broadleafed weeds such as dandelion, dock, and plantain may be controlled by 2,4-D in the early stages of their growth. Maturing weeds will not be controlled by the herbicide at the rate given. The rate recommended is two teaspoons of 2,4-D concentrate (which contains 4 pounds acid equivalent per gallon) in one gallon of water applied over 500 square feet.

When it is impractical to spray the material because of the danger to nearby ornamental or garden plants, the solution may be applied with a sponge fastened to a stick and touched to the weeds, or with a clothes sprinkler, or with a broom dipped into a bucket of solution and shaken over the area near the ground. A type of "weed gun", available at garden supply dealers, which can be placed over the individual weeds and the herbicide released by pressure on a plunger, is safe and effective.

If a sprayer is used, it should be operated at a low pressure and no spraying should be done at times when wind might carry droplets to ornamental or garden plants. Hose attached sprayers should not be used for the application of 2,4-D.

Spur weed may be controlled at the early stages of its growth (in September and October) by application of 2,4-D in the manner described above. Spur weed is the low, broad-leafed, winter growing plant which produces stickers in the spring and early summer. It is not to be confused with sandbur, the erect grass which produces large burs in midsummer.

Crabgrass may be controlled in Bermuda grass lawns by use of herbicides containing disodium methyl arsonate. This chemical is not recommended for use in St. Augustine grass and Zoysia grass lawns. As this material is formulated under several trade names and the concentration of active ingredient varies, it is recommended that the rates given on the manufacturer's label be used. Treatments should begin when crabgrass begins to germinate and retreatment at weekly intervals for 3 or 4 weeks will be required for good control. It should be noted that this material is an organic salt of arsenic, which is extremely poisonous. The material or the mixture must not be within the reach of children or animals and prolonged contact must be avoided by the user.

Dallis grass in Bermuda grass lawns may be eradicated by spot spraying the crowns only with diesel fuel or a naptha-type oil. Good success has also been obtained in eradicating heavy infestations of Dallis grass by covering the area with a clear plastic cover, such as Visqueen, for approximately one week during the hottest days of midsummer. The high temperatures produced under the cover kill the Dallis grass but Bermuda grass will recover within about three weeks or earlier if fertilized and watered. Dallis grass growing in the shade of trees or buildings is not controlled satisfactorily by this latter method. Some control of Dallis grass in Bermuda may be expected from the disodium methyl arsonate mentioned above, but treatment must begin early in the spring and be repeated every two weeks for several weeks.

White clover may be removed from Bermuda grass lawns with a solution of two tablespoons of 2,4,5-T concentrate in 5 to 10 gallons of water applied to 1000 square feet of lawn.

Bermuda grass that grows over driveways or walks or into flower beds and gardens may be kept under control by periodically spraying the borders or edges with a naptha-type oil. These oils are sold as cleaning fluids in bulk at service stations or gasoline distributors. Very low pressure should be employed to avoid any misting of the oil which may drift onto flowers or vegetables and damage them.

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[4] Portions of this section by Rex K. Lawhon, Graduate Assistant, Dept. of Plant Pathology & Phys., Mississippi Agricultural Experiment Station, State College, Mississippi.

The winter weeds henbit and common chickweed may be controlled satisfactorily by treating with a water spray of DNBP. Treatments should be made when the temperature is above 60°F. using a rate equivalent to 2 pounds active ingredient per acre in 40 gallons of water or four tablespoons in one gallon of water per 100 square feet. Established lawns, grasses and white clover recover quickly from this treatment. All handling precautions on the manufacturer's label should be followed and the spray should not come into contact with the foilage of desirable ornamental plants.

Establishment of a new lawn or rebuilding of areas of an old one may be facilitated by pre-seeding treatments. These chemicals kill weed seed, rhizomes and bulbs and then decompose in the soil, allowing planting of the lawn at a later date. All of these chemicals will kill growing plants and should not be applied where they may contact the roots of valuable plants. It is recommended that test plantings be made before planting the entire lawn in order to determine whether all of the chemical has left the soil. The time required for breakdown in the soil depends primarily on temperature. Chemicals and rates recommended for pre-seeding treatment in lawns are:

Granular cyanamide, 50 pounds per 1000 square feet. Mix 25 lbs. with the top 1½ inches of soil and apply 25 pounds to the surface. Keep the soil moist for 3 weeks before planting grass.

Mylone[5] 3/4 pound per 100 square feet. Apply dry and mix well into the top 6 inches of soil. Apply two inches of water to the treated area. After about two weeks, break the soil to allow the gaseous products of the chemical to escape and make a test planting two days later.

Vapum or VPM soil fumigant,[6] 1½ quarts per hundred square feet. The chemical is handled in the same way as the above, except that it is a liquid and is applied by mixing with water in a sprinkler can or with a hose-attached sprayer.

Specific Weeds

Nutgrass

Nutgrass, or coco, can be eradicated in small areas, such as lawns, flower beds, and gardens, by the use of methyl bromide. The method is too expensive and laborious for field use. The methyl bromide treatment also kills Johnson grass, Bermuda grass and many weed seeds. There is some evidence that nematode populations are reduced by methyl bromide fumigation.

Best results from the treatment are obtained when the soil is warm (above 50°F) moist but not wet, and has been spaded to a depth of about 10 inches. The spaded area to be treated is covered with a gas-proof cover, such as Sisalkraft paper, Visqueen, or rubberized tarpaulin. The cover must be elevated in the center. This is done by use of sacks filled with straw over which the cover is placed. The gas-proof cover is sealed by covering the edges with soil. The cover must be tight; any holes in it should be closed with gummed tape. One pound of methyl bromide per 100 square feet soil surface should be released under the cover into an open container. The area should remain covered for at least 48 hours. The treated area may be planted safely about two to three days after the cover is removed.

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[5] 3,5-dimethyl tetrahydro-1, 3-5, 2H thiadiazine-2-thione, sold as Crag Mylone 85W.

[6] Sodium N-methyl dithiocarbamate

Approximately 100 percent control may be expected, but an occasional tuber may escape. Do not let these few escaped "nuts" reinfest the area, as they will quickly do if left alone. Remove them at once.

Methyl bromide is poisonous and must be handled with care. The manufacturer's precautions must be observed. The chemical is odorless, but most commercial preparations contain added materials such as tear gas which give an odor that is easily detected. With proper care in application one can use methyl bromide in the open with very little risk. Methyl bromide may be obtained from several chemical manufacturers. One manufacturer is distributing it in small trial application kits. The cost is about $1.00 a pound.

Sweetpotatoes employed as a competitive crop in combination with cross-cultivation has practically eradicated nutgrass in three years. The procedure is: (1) Disk the area several times prior to setting out the potato slips. (2) Plant the potatoes in hills on 40-inch centers on flat seed beds; three slips per hill are adequate. (3) During the first cross-cultivation off-barr the potatoes both ways with disk hillers. (4) For the second cross-cultivation use scratchers or sweeps with fenders. Use this method as many times as potato vines will permit, about twice has been the limit. Harvest the potatoes late in the fall just prior to frost. Excellent yields of potatoes have been produced in this manner.

For spot infestations of nutgrass soil sterilants may be used.

Cypress Weed (Texas Cedar)

Use 2½ to 3 pounds of 2,4-D or 1½ pounds of 2,4,5-T per acre in 10 to 20 gallons of water as a broadcast spray. Where infestation is not heavy enough to justify broadcast spraying at these rates, spot spraying of small patches or individual plants may be advisable. Treat in late spring or early summer when plants are in active growing condition.

The above rates of these chemicals will severely injure or kill lespedeza, clovers, and other legumes. Avoid drift onto susceptible crops such as cotton.

Johnson Grass[7]

The method to use in controlling Johnson grass depends largely upon where the weed occurs and the extent of the infestation.

No satisfactory chemical is known for controling a heavy infestation of Johnson grass in a growing crop. In situations where it is impractical or too expensive to treat individual crowns or clumps of Johnson grass because of large numbers of the weed, cultural methods of control are suggested. The most effective means of cultural control has been a summer fallow plowing program, which is done 3 to 8 times at 2 to 4 week intervals. The number and intervals of the plowings are determined by the rate of growth of the grass as determined by weather conditions. A good program has been to grow winter oats for grain and begin the summer plowings after harvest. The oats should be well fertilized so that Johnson grass emerging before harvest will be retarded by the crop. Cross-plowed cotton is an excellent crop to plant following a fallow program.

If it is not possible to fallow during the summer, two winter fallow plowings, one in early November and one in January, will reduce the Johnson grass population to some extent.

In cases of a light infestation, or one which has been reduced by the above methods, small scattered clumps of grass should be spot treated by applying a naptha-type oil to the crowns 2 to 6 times per season to prevent vegetative growth in excess of 6 to 12 inches, or a wetting spray prepared by dissolving one pound of dalapon in 4 gallons of water. Sparse large clumps in cotton should be cut to the ground and the new growth treated with dalapon. Cotton and other crop plants coming into contact with either the oil or dalapon will be injured or killed.

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[7] Portions of this section by Rex K. Lawhon, graduate assistant, Mississippi Agricultural Experiment Station, State College, Mississippi.

In any clean-up program every effort should be made to prevent Johnson grass from producing seed, not only in the field itself but also along the turn rows, drainage ditches and fence rows. Any seed produced will threaten reinfestation of areas free of the weed.

Johnson grass growing in fence rows, along ditch banks and in drainage ditches may be controlled by applying 400 to 600 pounds per acre of sodium chlorate in solid form or as a spray to which 200 pounds of calcium chloride has been added; the latter compound reduces the fire and explosive hazard of sodium chlorate. Respraying or spot treatment should be done as required to kill any Johnson grass escaping the first application. In the handling of sodium chlorate great care should be exercised to follow in detail the instructions on the label of the container. Johnson grass may also be controlled in non-cultivated areas by the application of dalapon at the rates of 10 pounds per acre for the first application and 5 pounds per acre for subsequent applications. The chemical should be applied in at least 40 gallons of water to the foliage when the Johnson grass is about a foot high and repeated as often as is needed. This herbidice has little residual action and yearly treatment will be necessary.

Wild Onion

Good control of wild onions can be obtained by spraying with maleic hydrazide at the rate of 3 pounds in 20 gallons water per acre. This chemical is most effective when applied in late fall when a high percent of the onions have germinated and have shoots above the ground. Dormant bulbs will not be affected by the chemical. One should dig up several clusters of onions and examine them for dormant bulbs and make the spray application when practically all the bulbs have shoots above the ground. A spreader and sticker must be incorporated in the spray solution. A concentration of 0.05% has given good retention of the spray.

Until more information is available, maleic hydrazide should not be used on pastures sown for winter grazing. Farmers using this herbicide should follow the manufacturer's instructions on the label of the container.

In instances where wild onions present problems in producing certified seed of small grains an application of 2,4-D may be warranted. A low volatile ester of 2,4-D should be applied at a dosage of 1½ lb. per acre in 20 gallons of water. This treatment usually prevents the development of the troublesome onion heads which contaminate the grain. Application should be made when onions have emerged to a maximum stand but before the stems of the small grains have elongated. Some injury to the crop may result from the 2,4-D ester but this is usually more than offset by the benefits derived from preventing onion head development.

For wild onion control in established permanent grass-legume pastures, 2 applications each year of 2,4-D for 2 or more years may be required. The first application of one pound per acre should be during the period October to December, and the second application of one pound per acre during the period February to the first part of April. If injury to legumes is not a consideration, two pounds per application is more effective.

For small areas such as lawns, flower beds, and gardens the methyl bromide treatment described for nutgrass may be used.

Brush Control

It is often necessary to remove brush or undesirable trees from ditch banks, right-of-ways, woodlands, pastures, etc. When hand cutting or grubbing methods are used, this work not only is expensive, but usually must be repeated. Chemicals will normally reduce the cost of such an operation and may give much longer control.

Recommended Chemicals and Precautions

Ammonium sulfamate (sold commercially as Ammate) is marketed in a crystalline form which should be mixed with water when this chemical is applied to frills or as foliage sprays. When stumps or notches are to be treated, ammonium sulfamate is usually applied in the crystalline form.

This material is very corrosive. Spray guns and other metal equipment should be cleaned promptly and thoroughly after each use and flushed with diesel oil or kerosene. Prolonged handling of ammonium sulfamate may irritate the skin. Care should be taken when applying ammonium sulfamate since it is likely to injure or kill any vegetation it touches. It should not be sprayed or spilled on desirable plants.

2,4,5-T and 2,4-D are commonly marketed as liquid concentrates, usually containing 4 pounds of acid equivalent per gallon. They are also marketed as special "brush killer" mixtures. They must be diluted for use. The diluent will depend on the method of application used, but may be either oil or water. See Table 5.

These chemicals are not corrosive and are not irritating when mixed with oil or water. They are hazardous to many plants and due care should be exercised in their use.

Sodium arsenite is one of the most effective materials available for killing undesirable bottomland hardwoods. It is most often applied as 61.5 percent sodium arsenite and can be bought either ready to apply or prepared by mixing white arsenite and caustic soda. Mixing instructions are available in Mississippi Agricultural Experiment Station Circular 139.

Sodium arsenite is an extremely poisonous compound and should not be allowed to contaminate clothing or get on the skin. Any containers used to mix or store this chemical should be destroyed or stored beyond the reach of humans or animals. Water that is polluted with so-

Table 5. Mixtures of chemicals for various methods of applications.

Methods of application	Chemical	Dosage or mixture[1] of chemical
Frills	Ammonium sulfamate	4 pounds to 1 gallon of water
	2,4,5-T Ester	1 gallon to 50 gallons of water or oil
	2,4-D, + 2,4,5-T Esters	1 gallon to 50 gallons of water or oil
	Sodium Arsenite	Use 61.5 percent Sodium Arsenite solution
Stump	Ammonium sulfamate	1 tablespoon crystals per 2 in. of stump diameter
	2,4,5-T Ester	1 gallon to 20 gallons of oil
	2,4-D + 2,4,5-T Esters	1 gallon to 20 gallons of oil
	Sodium Arsenite	Use 61 percent Sodium Arsenite solution
Foliage Spray	Ammonium sulfamate	1 pound to 1 gallon of water
	2,4,5-T Ester	1 gallon to 200 gallons of water
	2,4-D + 2,4,5-T Esters	1 gallon to 200 gallons of water
Basal Spray	2,4,5-T Ester	1 gallon to 20 gallons of oil
	2,4-D + 2,4,5-T Esters	1 gallon to 20 gallons of oil
Notches or Cups	Ammonium sulfamate	1 tablespoon crystals per notch

[1] Mixture of 2,4,5-T and 2,4,-D are based on commercial formulation of the low volatile esters containing 4 pounds of 2,4,5-T or 2,4-D per gallon (acid equivalent).

dium arsenite will kill fish and any animals, wild or domestic, that drink it.

Methods of Application

Frills: A water solution of ammonium sulfamate may be poured into single hack girdles or overlapping ax cuts encircling the tree at a convenient chopping height. Sodium arsenite should be applied to the frill with a pump oiler.

2,4,5-T may be applied either in water or oil, but the oil treatment is usually superior. Frill treatments are more effective when applied in the spring when the trees are leafing out.

Stumps: Ammonium sulfamate crystals at the rate of 1 tablespoonful per 2 inches of stump diameter may be placed on the stump tops. An oil solution of 2,4,5-T, or a mixture of 2,4-D and 2,4,5-T, should be sprayed to run off on the tops and sides of the stumps. If sodium arsenite is used, the top of the stump should be thoroughly wet with the material. All of the above mentioned stump treatments should be applied within 36 hours after cutting.

Foliage Spray: Ammonium sulfamate, 2,4,5-T or a mixture of 2,4-D and 2,4,5-T may be used as water solutions. A mixture of 2,4-D and 2,4,5-T is suggested for the control of mixed brush species, some of which are tolerant to 2,4-D but not to 2,4,5-T and vice versa. Such treatments are more effective on sprouts no older than 2 years and on brush up to 6 feet tall. The foliage, twigs and limbs must be wet to the point of "runoff" and application should be during the growing season after leaves are fully expanded. Repeat treatments for 2 or more years may be required for some species.

Basal Spray: 2,4,5-T or a mixture of 2,4-D and 2,4,5-T in oil should be sprayed on a band of bark completely around the base of the tree. If the stems are under 2 inches diameter at breast height, a band 12 inches wide can be used, but when larger stems are treated the band should be 24 inches wide. This can be done at any time of the year.

Notches or Cups: A series of notches equalling one-half the diameter of the tree in inches at breast height should be cut at the base of the trees and each notch treated with 1 tablespoonful of ammonium sulfamate. This treatment may be applied at any time of the year.

Soil Sterilization

Under some conditions it is desirable to prevent growth of all vegetation on certain areas, for example, fence rows, ditch banks, rights-of-way, industrial sites, etc. Herbicides useful for this purpose are given in Table 6. Applications for the control of perennial species have given best results when applied in the fall, whereas annual weeds are more easily controlled by treatments made in the spring. For best results vegetation on the area to be treated should be cut off to a height of about 6 inches and removed in order to insure good coverage of the soil. Soil type, rainfall and other factors influence the effectiveness of the chemicals. When vegetation begins to reappear on the treated areas, another application is needed. Retreatments made at ¼ to ½ the original dosage are generally adequate to maintain the area free of weeds.

The herbicide monuron should not be used near desirable trees and ornamentals nor where it may come into contact with the roots of these species by water movement. Although less hazardous than monuron, the other soil sterilants should be used with care around valuable species or on ditchbanks, turnrows, etc., where water movement may carry them into other areas. Instructions and precautions given on the manufacturer's label should be strictly observed.

Table 6. Herbicides for use in soil sterilization.

Herbicide[1]	Active Ingredient	lb./100 Sq. Ft.	Lb. Per Acre	Vegetation	Approx. Duration
Borascu-44	B_2O_3 44%	7-11	3000-4800	Annuals and most shallow rooted perennials	1 yr.
Concentrated Borascu	B_2O_3 61.5%	5-9	2200-3900	Same as above	1 yr.
DB Granular	Sodium borates—90.5% 2,4-D—7.5%	1-3	435-1300	Broad-leafed annuals and shallow rooted perennials. Not recommended for grasses	1 yr.
Polybor Chlorate	B_2O_3 49% $NaClO_3$ 25%	2-4	870-1740	Same as above	1 yr.
Monuron[2]	3-(p-chlorophenyl) 1, 1-dimethyl urea 80%	1½-3 oz.	40-80	Annuals and most shallow and deep-rooted perennials	2-3 yr.
Sodium Chlorate	$NaClO_3$ 99%	1½-2	650-870	Annuals and most shallow and deep-rooted perennials	1 yr.
Sodium TCA	Na trichloro-acetate 90%	2-4	870-1740	Same as above	1 yr.
Ureabor	Sodium borates 94% Monuron—4%	1-2	435-870	Same as above	1 yr.

[1] The active ingredient of these herbicides may be available under different trade names. These may be used also, but the active ingredient applied should approximate those given in the table.

[2] Marketed as Telvar W. and Karmex W.

Equipment For Weed Control

General Spray Equipment

The sprayers discussed in this publication are tractor-mounted machines. They consist of a power-takeoff-driven pump, fuel delivery hoses, tank or tanks, pressure regulator, pressure gauge, and boom or individually mounted nozzles.

Pumps: Pumps are rated in gallons-per-minute discharge at specific speeds. The capacity of the pump should be about twice that of the total nozzle delivery rate. This extra capacity will provide an overflow to be by-passed back to the tank, which in turn will help assure a uniform rate to the nozzles, provide agitation in the tank, and as wear takes place will increase the life of the pump. The pump should be loosely chained to the tractor or frame of the sprayer.

Hoses: Sprayer hose should be resistant to aromatic petroleum solvents. The hoses leading from the tank to pre-emergence and post-emergence nozzles should be of equal length and size. Sharp kinks in the hose should be avoided. Hose fittings should have adequate openings to avoid restrictions in the lines.

Pressure regulators: The regulator should be of a type that will hold the pressure constant with a minimum

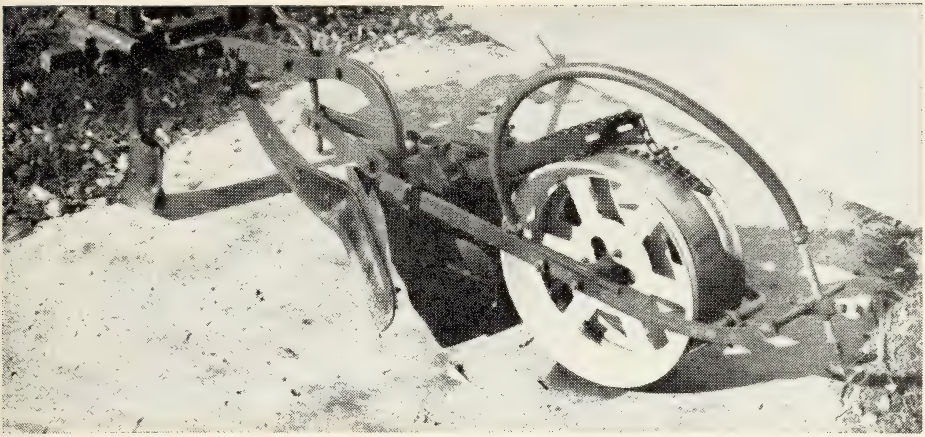

Figure 3. Conventional open center press wheel modified by closing center with sheet metal band and with spray nozzle centered to the rear.

amount of pulsation. Most regulators have a fitting attachment for the pressure gauge. The gauge should give an accurate reading since pressure is a vital factor in controlling the amount of material being applied.

Tanks: Tanks should be thoroughly cleaned of rust, scale, or other foreign matter before using. Oil drums that are used for tanks can be cleaned and coated with oil between seasons. When they become corroded and hard to clean, they should be discarded.

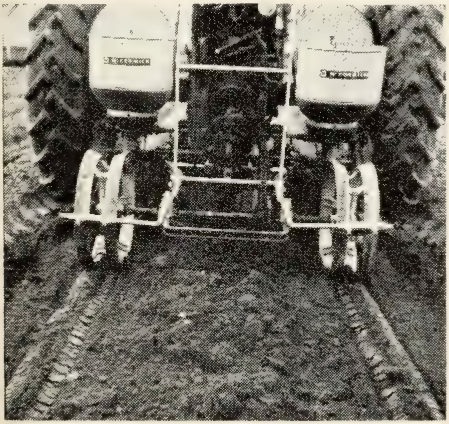

Figure 2. Conventional open center planter press wheels. Nozzles can be added behind these wheels for pre-emergence spraying.

Strainers: A line strainer (50-mesh) should be installed on the intake side of the pump. Fifty-mesh screens should be placed just behind each nozzle tip of greater capacity than 0.1 gallon per minute, and 100-mesh screens should be used for tips smaller than these.

Special Applicators

Pre-emergence: If herbicidal oils are not to be used, a simple drop-nozzle back of the press wheel is all that is needed (Figure 3). If herbicidal oils are to be used, a flat roller (16 inches wide) behind, or in lieu of, the split press wheel is necessary (Figure 4). Width of the band is

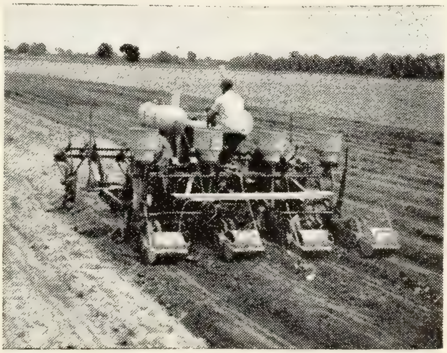

Figure 4. Wide flat rollers are excellent when post-emergence treatments are to follow.

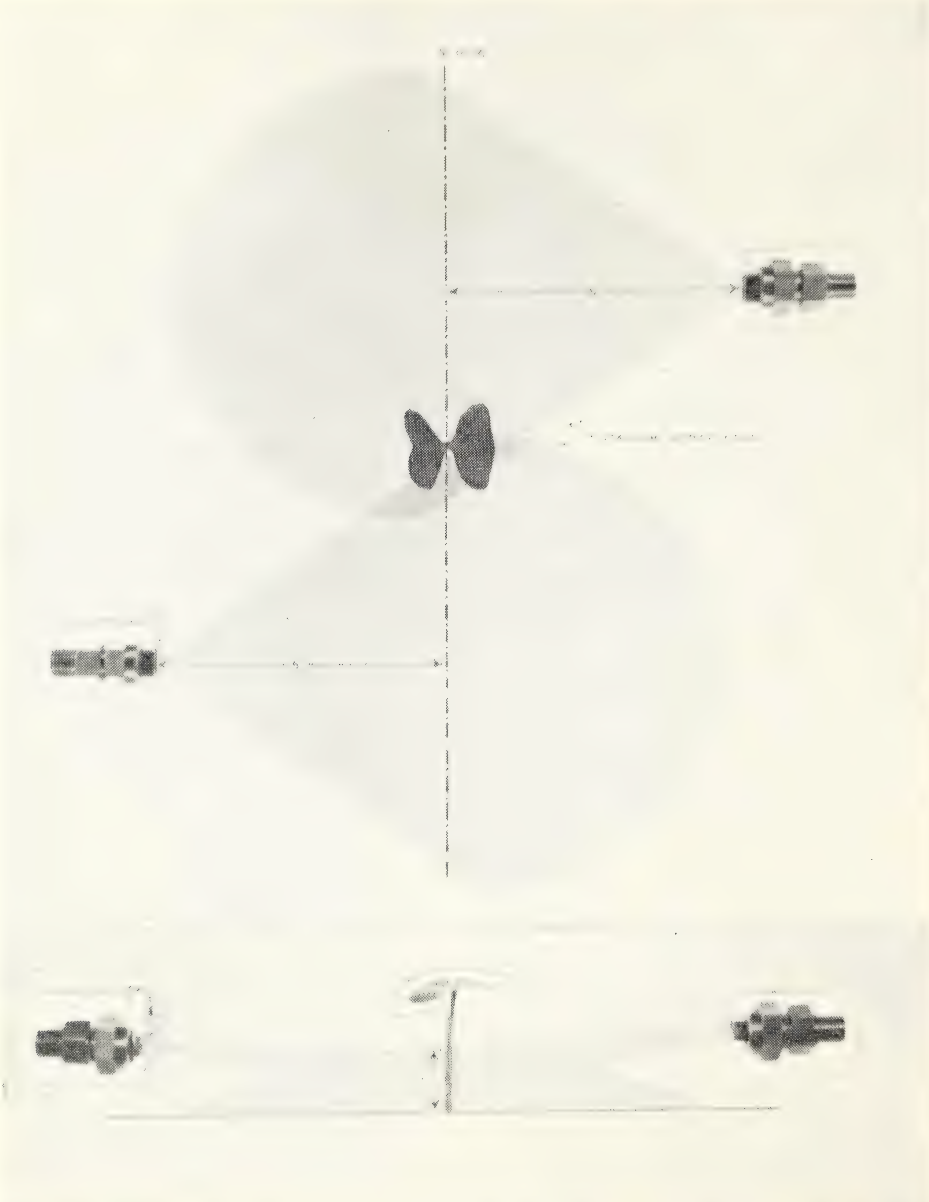

Figure 5. Schematic illustration of proper nozzle setting for applying post-emergence oils.

controlled by adjusting the height of the nozzle (about 7 inches for a 12-inch band)

Post-emergence oil applcators and cultivation equipment for preserving treated bands: Cultivation of the side of the row next to the treated band and application of the oil are normally combined. The operations can be separated, however, and this will be advantageous when the fields are too wet to cultivate, but are dry enough to permit application of the oil. Cloddy beds, uneven beds, extremely dry and powdery soil and other undesirable field characteristics will affect adversely the performance of all types of equipment. Some of these conditions can be prevented largely by good seedbed preparations and maintenance of correct equipment settings; for others no preventive measures can be taken, but they can usually be overcome by special setting of equipment. Any such special setting of equipment should not change the rate or method of oil application. Regardless of the equipment or methods used, the oil application and cultivation should insure proper placement of the oil, effectively join cultivation of the middles to chemical control in the treated band, keep loose soil and clods out of the drill area, and leave the shoulder of the treated band smooth and level so that future applications of oil or flame can be made. Spacings of nozzles and cultivating implements presented in Figures 5, 7 and 10 apply to all types of implements. The oils must be applied from fan-type nozzles. Several types of equipment are available, and of which the following are generally typical:

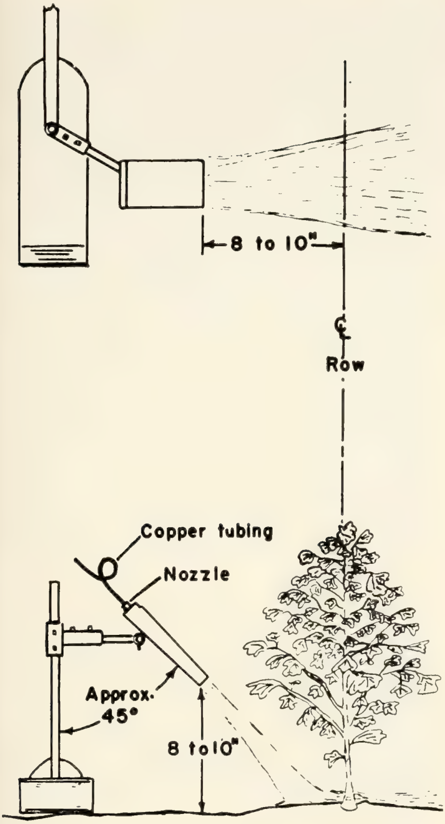

Figure 6. Flat burner adjustment.

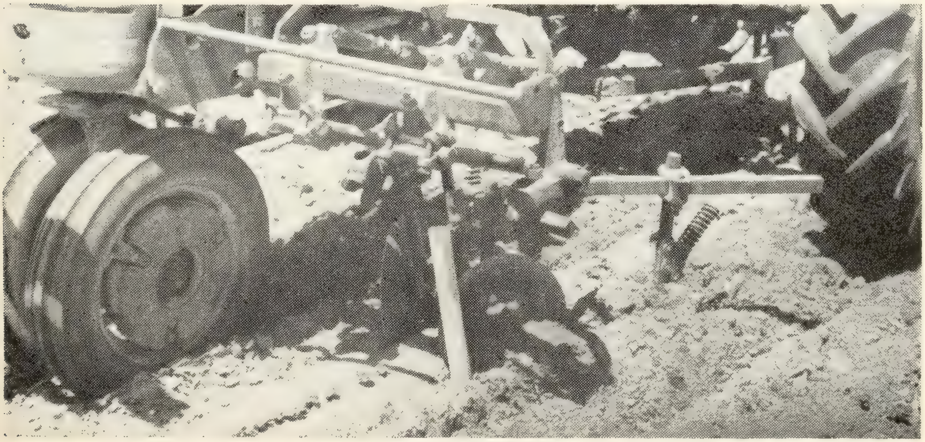

Figure 7. Disk-hillers.

1. Parallel-action shoes and shield-type sweeps (Figure 9). The shoes serve as carriers and gauges for the spray nozzles and may be bolted to the shank of the shield-type sweep. With the sweep at the proper depth in the soil, the front of the shoe should be about 1/4 inch off the ground, with the rear part firmly on the soil. The parallel arms should be pointed backward at an angle of 45 degrees. The shield-type sweeps are used to cultivate the area next to the treated band. They should be set with the shield section parallel to the row, or with the leading end pointing very slightly toward the row ("toed-in at the front"). They should be set deep enough to cut the weeds just below the soil; neither sliding over the tops of the weeds, nor passing so far beneath the roots that the weed is not cut (about 1/2 to 3/4 inches deep). These shield-type sweeps may be used without the oil applicators for cultivation or cross-cultivation where it is necessary to protect a treated band from loose soil.

2. Parallel-action fenders and broad-angle, low-crown, high-speed sweeps (Figure 10). These fenders serve as carriers and gauges for the spray nozzles, and to protect the drill area from loose soil. Each fender is placed to the inside of a front sweep, with the midpoint (lengthwise) of the appicator just opposite the tip of the sweep wing. As with the parallel-action shoe, the front of the fender should be about ¼ inch higher than the rear, and the parallel arms should point backward at a 45-degree angle when in the operating position. This position allows the fender to move up or down with the contour of the row.

The highspeed sweeps should be set relatively flat and shallow, and are used to accomplish the same job as the shield-type sweeps. Likewise, they can be used in combination with the fenders when no oil is being applied.

3. Disk-hillers: Disk-hillers (Figure 7) are particularly effective for cultivation, cross-cultivation, and protection of a treated band when no oil is being applied. They should be run just deep enough to clear out the weeds. A following sweep is used to refill the trench left by the disk-hiller.

4. Rotary Shields: Rotary shields (Figure 8) combined with highspeed sweeps also offer a simple way of cultivation,

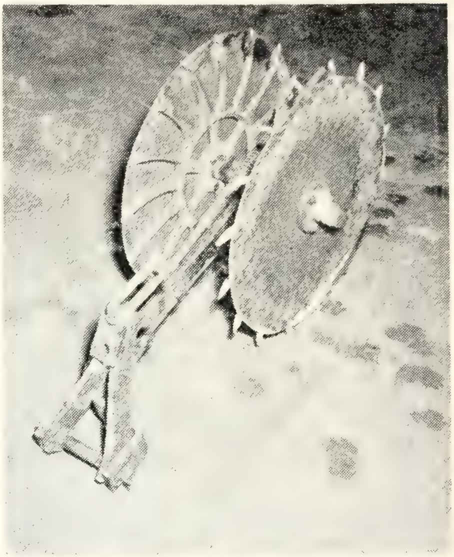

Figure 8. Rotary hoe shielded with circular metal.

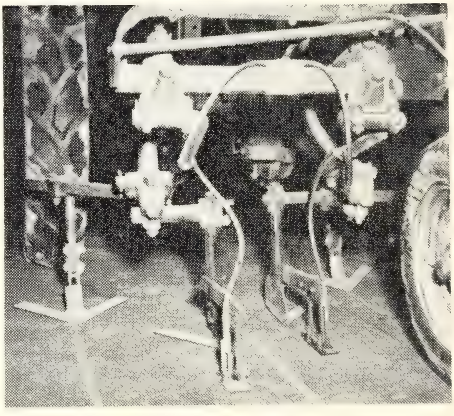

Figure 9. Parallel action shoes and shield-type sweeps—lines on floor representing middles and drills facilitate adjustment.

cross-cultivation, and protection of a treated band when no oil is being applied. These shields are made by bolting a circular piece of metal (½ inch smaller in diameter than the rotary hoe) to each outside hoe of a 4-hoe rotary hoe. The two inside hoes are removed.

Flame Cultivators: See Mississippi Agricultural Experiment Station Bulletin 545.

Boom-Type Sprayers

Boom type sprayers may be equipped with two long-drop-nozzles per row for spraying corn, or may be used with short drops for spraying in small grains, rice, smooth pastures, and other operations.

As a general rule, broadcast booms for weed control should be fitted with fan-type nozzle tips that produce a heavy-center spray pattern (conventional type) so that over-lapping of the patterns does not produce strips that are double sprayed, as would be the case with even-distribution tips.

Boomless Sprayers

This type sprayer consists of a cluster of nozzles in a single fitting (Figure 11). They are useful over rough terrain and where even spray distribution is not essential. Wind is a factor in using these nozzles. Spraying on a windy day requires extra precautions to obtain good coverage and to avoid drift hazards.

Calibration charts should be consulted under the column "Total Capacity in G. P. M." to be sure that the pump on the sprayer has an adequate capacity.

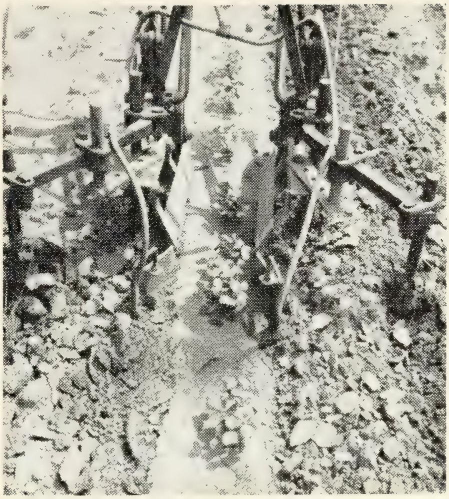

Figure 10. Shield-type applicator in conjunction with highspeed sweeps.

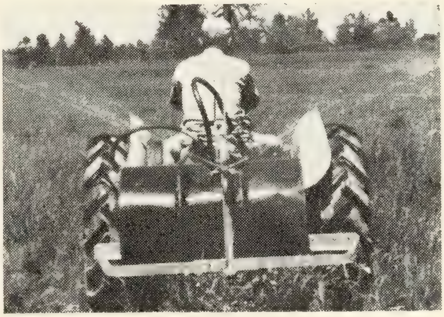

Figure 11. Spraying pasture with cluster nozzle.

Calibration of Spray Equipment

All spray equipment should be calibrated. Good calibration will insure the correct dosage to control weeds, eliminate damage to crops caused by the application of too much chemical, as well as avoid extra costs due to excess rates.

Pre- and Post-Emergence Equipment for Band Treatments

Total volumes of spray application for pre-emergence herbicides can usually range from 6 to 12 gal./A on a 12-inch band without appreciable differences in results. Some researchers have reported, however, that in some tests total volumes less than 12 gal./A gave poorer weed control than the more standard rate of 12 gal./A. Calibration is also more critical with the lower volume of application.

Calibration of a spray machine is easy and simple, if confusing factors are not added.

The rate of application for this type of spraying depends upon speed of machine, size of nozzle, and pounds of pressure. The number and spacing of nozzles is constant for pre-emergence spraying (1 per row) and for post-emergence spraying (2 per row), and therefore will not need to be considered in the use of this calibration procedure. The actual width of the rows can also be ignored since this calibration table can be used for all row widths. If the rows are wider or narrower than 40 inches, the amount of herbicide actually used per acre will not be equal to that calculated, but the amount that is actually applied on the band will be the recommended amount.

The procedure for calibrating a tractor sprayer should be as follows: First, get all equipment on the tractor operating in and on the ground properly. Second, time the tractor in seconds over a measured course of 300 feet with the tractor at full throttle in the desired operating gear. Third, from the speed found in feet per second find the speed of the tractor in miles per hour in Table 7. Fourth, read across the table and find correct nozzle or tip size, approximate gauge pressure, and the number of seconds it will take to fill one quart from 1 nozzle.

For example: The speed of tractor is 300 feet in 68 seconds or 3.0 mph, and it is desired to spray 5 gallons per acre of herbicidal oil. An 800050 size nozzle tip operating at 32 pounds of pressure per square inch would be required. This size nozzle tip at the 32 pound p.s.i. should deliver 1 quart in 297 seconds. If one quart is not delivered in the time specified, adjust pressure until one quart is filled in the given time. All nozzles of the machine should be calibrated.

Things to be considered for efficient sprayer operation are:

1. Rust free tank and lines.

2. Use clean water in the pre-emergence spray mixture.

3. Strain mixture as it is poured into tank.

4. Wash out the sprayer immediately after each operation and also before next operation if there is any time lapse.

General Broadcast Spraying

Boom type sprayers - Where rate of application is not critical the data given in Table 8 will provide for reasonably accurate volumes of application, and will serve as an aid in selection of nozzle size and pressure for a specified need. Speed should be accurately determined by the method outlined in Table 7.

Where the rate of application may be critical (as in post-emergence spraying of young corn) an accurate calibration is desirable. Accurately determine the speed of the sprayer as described above. Select the appropriate nozzle size and approximate pressure for the determined speed from Table 8. Then determine the number of seconds to fill one quart from one nozzle at the desired rate of application by use of the following formula:

$$\text{Seconds to fill 1 quart from 1 nozzle} = \frac{89100}{\text{(nozzle spacing in inches)} \times \text{(gal./A)} \times \text{(MPH)}}$$

Example: To spray 11 gallons per acre with nozzles spaced 22 inches apart on a spray rig that travels 300 feet in 49 seconds.

1. Speed = 4.2 MPH (Table 7)
2. Nozzle tip and approximate pressure = 8002 at about 30 PSI (Table 8)
3. Seconds/quart = $\frac{89100}{(22)\ (11)\ (4.2)} = 87.66$
4. Adjust pressure until one nozzle delivers 1 quart in 88 seconds (check one or all nozzles)

Adjust pressure until one nozzle delivers 1 quart in 88 seconds (check several or all nozles)

Boomless sprayers- Precision spraying is usually not done with boomless sprayers, and therefore use of calculated application data rather than calibration is usually satisfactory. The calibration table (Table 9) is reprinted with the manufacturer's consent.

Table 7. Calibration data for pre- and post-emergence herbicidal sprays.

M.P.H.	Seconds to travel 300 ft.	Nozzle sizes[1]	Approx. gauge pressure (p.s.i.)	Seconds to fill 1 qt. from 1 nozzle	Nozzle sizes[1]	Approx. gauge pressure (p.s.i.)	Seconds to fill 1 qt. from 1 nozzle
			PRE-EMERGENCE APPLICATIONS				
	12 gals./acre[2] water solution				6 gal./acre[2] water solution		
2.2	93	8002	32	84	8001	32	168
2.4	85	8002	38	77	8001	37	154
2.6	79	8003	20	71	8001	45	142
2.8	73	8003	23	66	80015	22	132
3.0	68	8003	26	62	80015	26	124
3.2	64	8003	30	58	80015	29	116
3.4	60	8003	34	55	80015	33	110
3.6	57	8003	38	52	8002	21	104
3.8	54	8004	24	49	8002	23	98
4.0	51	8004	26	46	8002	26	92
4.2	49	8004	29	44	8002	30	88
4.4	46	8004	32	42	8002	33	84
4.6	44	8004	35	40	8002	36	80
4.8	43	8004	38	39	8002	38	77
5.0	41	8004	41	37	8002	40	74
			POST-EMERGENCE OILS				
		5 gal./acre[3]				7 gal./acre[3]	
2.2	93	800050[4]	17	404	650067[4]	18	289
2.4	85	800050	20	370	650067	22	266
2.6	79	800050	24	342	650067	26	245
2.8	73	800050	27	318	650067	30	227
3.0	68	800050	32	297	650067	34	212
3.2	64	650067	20	278	8001	18	199
3.4	60	650067	23	262	8001	20	188
3.6	57	650067	25	247	8001	22	177
3.8	54	650067	28	234	8001	25	168
4.0	51	650067	31	222	8001	27	159
4.2	49	650067	34	212	8001	30	152
4.4	46	8001	15	202	8001	33	144
4.6	44	8001	19	193	80015	16	139
4.8	43	8001	20	185	80015	18	133
5.0	41	8001	22	178	80015	19	127

[1] Other type nozzles with correct degree of angle and orifice size may be substituted for nozzles listed.

[2] Total gallons solution per acre on 12-inch band with rows spaced 40 inches apart, 1 nozzle per row.

[3] Total oil per acre with rows spaced 40 inches apart.

[4] Two nozzles required per row for herbicidal oils.

Table 8. Calibration for broadcast spraying in gallons per acre with nozzles spaced 20 inches apart.

Nozzle size	Pressure	Speed in miles per hour[1]															
		2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	6.0	7.0	8.0
	20	8.0	7.6	7.1	6.6	6.2	5.9	5.5	5.2	5.0	4.8						
	30	10.4	9.7	8.6	8.5	7.9	7.6	7.1	6.8	6.4	6.1	5.8	5.7	5.1			
8001	40	11.5	10.8	10.0	9.4	8.8	8.4	7.9	7.5	7.1	6.8	6.5	6.3	6.0	5.0		
	20	12.6	11.9	10.5	10.3	9.7	9.2	8.7	8.2	7.8	7.5	7.2	6.9	6.3	5.5		
	30	15.0	14.0	12.9	12.2	11.4	10.9	10.3	9.8	9.2	8.8	8.4	8.2	7.7	6.5	5.6	
80015	40	17.2	16.2	14.9	14.1	13.2	12.6	11.8	11.2	10.6	10.2	9.8	9.4	8.9	7.5	6.4	
	20	16.1	15.1	14.0	13.2	12.3	11.8	11.1	10.5	9.9	9.5	9.1	8.8	8.4	7.0	6.0	5.2
	30	19.6	18.4	17.2	16.0	15.0	14.3	13.4	12.8	12.1	11.6	11.0	10.7	10.3	8.5	7.3	6.3
8002	40	23.0	21.6	19.8	18.8	17.6	16.8	15.8	15.0	14.2	13.6	13.0	12.6	11.8	10.0	8.6	7.4
	20	24.2	22.7	20.9	19.7	18.5	17.6	16.6	15.8	14.9	14.3	13.6	13.2	12.6	10.5	9.0	7.8
	30	29.9	28.1	25.8	24.4	22.9	21.8	20.5	19.5	18.5	17.7	16.9	16.4	15.4	13.0	11.2	9.6
8003	40	34.5	32.4	29.6	28.2	26.4	25.2	23.7	22.5	21.3	20.4	19.5	18.9	17.8	15.0	12.9	11.1
	20			28.0	26.3	24.6	23.5	22.1	21.0	19.9	19.0	18.2	17.6	16.8	14.0	12.0	10.4
	30			34.3	32.9	30.8	29.4	27.6	26.2	24.8	23.8	22.8	22.0	18.7	17.5	15.0	13.0
8004	40			39.6	37.6	35.2	33.6	31.6	30.0	28.4	27.2	26.0	25.2	20.6	20.0	17.2	14.8

[1] Speed of tractor should be determined in the manner previously described (see Table 1).

Example: It has been determined that the speed of the tractor is 3.4 miles per hour and a total volume rate of 15 gallons per acre is to be used. Read down under 3.4 in the "speed" column to 15.0; this shows that an 8002 nozzle should be employed at 30 p.s.i. If 2,4-D is to be applied at a rate of 1½ pound per acre, three pints of the 2,4-D concentrate (containing 4 pounds of acid equivalent per gallon) is added to the 14-3/4 gallons of water.

Table 9. **"BOOM JET," Spraying Systems, Bellwood, Illinois.**

Nozzle No.	OC TIP "A"	VEEJET "B"	VEEJET "C"	Angle "V"	Liquid Pressure p.s.i.	Total Capacity G.P.M.	"L" Feet	GALLONS PER ACRE 3 M.P.H.	4 M.P.H.	5 M.P.H.	6 M.P.H.	8 M.P.H.	10 M.P.H.
430 ¾ 2T0C10	OC 10	¼U 0508HE	¼VV11004	58°	10	2.0	38	8.7	6.5	5.2	4.4	3.3	2.6
				58°	15	2.5	39	10.4	7.8	6.3	5.2	3.9	3.2
				61°	20	2.8	39½	11.9	8.9	7.1	6.0	4.5	3.6
				61°	30	3.5	40	13.9	10.4	8.3	7.0	5.2	4.2
				61°	40	4.0	40½	15.9	11.9	9.5	8.0	6.0	4.8
				61°	60	4.9	41	19.2	14.4	11.5	9.6	7.2	5.8
430 ¾ 2T0C20	OC 20	¼U 0520HE	¼VV9506	49°	10	4.3	41	17.3	13.0	10.4	8.7	6.5	5.2
				51°	15	5.3	43	20.2	15.1	12.2	10.1	7.6	6.1
				53°	20	6.1	47	21.4	16.1	12.8	10.7	8.1	6.4
				53°	30	7.5	50	24.6	18.5	14.7	12.3	9.3	7.4
				53°	40	8.6	52	27.3	20.4	16.4	13.7	10.2	8.2
				53°	60	10.5	54	32.2	24.1	19.3	16.1	12.1	9.7
430 ¾ 2T0C40	OC 40	¼U 0540HE	¼U 9510	51°	10	8.5	48	29.2	21.9	17.5	14.6	11.0	8.8
				51°	15	10.4	52	33.0	24.7	19.8	16.5	12.4	9.9
				53°	20	12.0	56	35.8	26.9	21.5	17.9	13.5	10.8
				53°	30	14.7	60	40.5	30.3	24.3	20.3	15.2	12.2
				53°	40	17.0	63	44.5	33.4	26.7	22.3	16.7	13.4
				53°	60	20.8	66	52.1	38.9	31.2	26.1	19.5	15.6

Handling and Mixing Herbicides

Precautions

All agricultural chemicals should be handled with care. The manufacturer's label on the container includes directions for safe handling. When material is spilled on the body, it should be washed off immediately. All of the materials are not toxic, but most of them are irritating to the skin. In no case should the spray orifice tips be placed to the lips to blow out trash. Many of the materials are flammable and should be handled accordingly.

Any equipment used for applying 2,4-D should not be employed for applying insecticides or herbicidal oils to cotton or other broadleaf crop plants. It is safe to spray livestock with 2,4-D sprayers but after each use the spray tank, lines, nozzles and pump should be drained and washed thoroughly with water containing a good household detergent. The tractor used in spraying 2,4-D should be thoroughly washed and steamed before using in growing cotton. Only the amine salts and low-volatile esters of 2,4-D should be used for weed control. Vapors arising from fields sprayed with volatile esters may cause serious injury to growing cotton and certain other plants.

If cotton is growing adjacent to fields being sprayed with 2,4-D, there is considerable risk of injuring the cotton seriously, particular if wind is blowing toward the cotton. If calm periods are chosen for applying treatments of 2,4-D and low spray pressures are employed it can be applied safely to fields adjacent to cotton. If corn is being treated it may be advisable to leave a few rows of corn untreated next to the cotton to serve as a buffer against spray drift.

Mixing Herbicides

The manufacturer's label gives the number of pounds of active material per gallon of the herbicidal concentrate, or for powders, the percentage of active ingredients. Instructions on the manufacturer's label pertaining to personal hazards in handling should be read and strictly observed. The proper amount of the formulated concentrate is mixed with water as set forth in Table 11 below. The concentrate should not be poured into an empty tank; fill the tank about 1/2 full with water, add the herbicidal concentrate and then complete filling with water. Allow the sprayer to operate with the nozzles cut off, by-passing the liquid through the tank for several minutes to insure thorough mixing.

See Table 11.

Table 10. Gallonage chart, Hanson Broadjet BJ 10-20 field spraying cluster (2—BJ 10-20 nozzles and 1 — No. 10 center tip).

Actual Swath	GALLONS PER ACRE AT 40 LBS. PRESSURE					GALLONS PER ACRE AT 60 LBS. PRESSURE				
in Feet	3 MPH	4 MPH	5 MPH	8 MPH	10 MPH	3 MPH	4 MPH	5 MPH	8 MPH	10 MPH
68	14½	11	9	5½	4½	17½	13	11	6½	5
66	15½	11½	9	5½	4½	18½	14	11	6½	6
64	16	11½	9	6	5	19	14	11	7½	6
62	16½	12	9½	6	5	19½	14½	11½	7½	6
60	16½	13	10	6	5	19½	15½	11½	7½	6
58	17	13	10½	6½	5½	20½	15½	12½	8	6½
56	18½	13½	11	6½	5½	22	16	13	8	6½
54	19	14	11	6½	5½	22½	17	13	8	6½
52	19½	14½	11½	7½	6	23½	17½	14	9	7½
50	20	15½	12	7½	6	24	18½	14½	9	7½

NOTE: (1) Gallonage calculated to nearest one-half gallon. (2) For 2 MPH GPA figure, double 4 MPH GPA figure. (3) For 1 MPH GPA figure, triple 3 MPH GPA figure.

Table 11. Amounts of chemical to add to make 50 gallons of spray mix for band spraying where rows are 40 inches wide or for broadcast spraying in general[1]

Crops	Materials	Lbs. active ingredient per gallon	Soil type	Band or broadcast	Pre- or post-emergence	Spray volume per acre	Chemical to add to make 50 gallons
						Gallons	Pints
Cotton	CIPC	4	Medium sandy loams	12" band	Pre-	12	12
Cotton	CIPC	4	Very fine sandy loams	12" band	Pre-	12	18
Cotton	CIPC	4	Silt loams	12" band	Pre-	12	20
Cotton	CIPC	4	Clay loams	12" band	Pre-	12	24
Cotton	Diuron	3	Medium sandy loams	12" band	Pre-	12	2
Cotton	Diuron	3	Very fine sandy loams	12" band	Pre-	12	3
Cotton	Diuron	3	Silt loams	12" band	Pre-	12	4
Cotton	Diuron	3	Clay loams	12" band	Pre-	12	6
Soybeans[2]	NPA	2	Medium sandy loams	12" band	Pre-	12	10
Soybeans	NPA	2	Very fine sandy loams	12" band	Pre-	12	15
Soybeans	NPA	2	Silt loams	12" band	Pre-	12	20
Soybeans	NPA	2	Clay loams	12" band	Pre-	12	30
Corn	2,4-D	4	All	Broadcast	Post-	10[2]	3 to 5
Corn	DNBP	3	Sandy loams	12" band	Pre-	12	17
Corn	DNBP	3	Silt loams	12" band	Pre-	12	22
Corn	DNBP	3	Clay loams	12" band	Pre-	12	28
Pastures	2,4-D	4	All	Broadcast	Pre- or post-	10[3]	7 to 10
Rice	2,4-D or 2,4,5-T	4	All	Broadcast	Post-	10[2]	8 to 12
Rice	2,4-D or 2,4,5-T	4	All	Broadcast	Early post-	10[2]	5
Rice	MCPA or 2-(2,4,5-TP)	4	All	Broadcast	Post-	10[2]	10 to 15
Rice	MCPA or 2-(2,4,5-TP)	4	All	Broadcast	Early post-	10[2]	7
Smallgrains	2,4-D or 2,4,5-T	4	All	Broadcast	Post-	10[2]	7 to 10

[1] These figures represent averages; see section on the crop in question for more detailed rate recommendations.

Other volumes can be computed by multiplying or dividing amount of chemical required for 50 gallons by fractional part needed, that is, for 100 gallons: 2 × amount; for 30 gallons: 3/5 of chemical.

[2] Soybeans recommendations for trial use only.

[3] Use 1/2 of the listed rate of chemical where 20-gallon volume-per-acre is used.

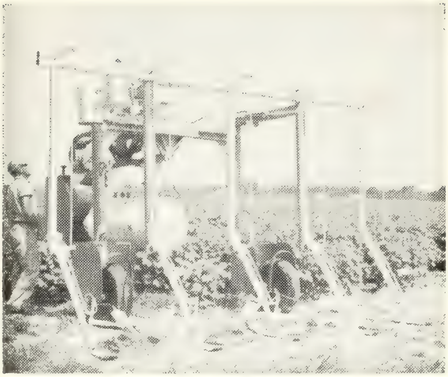

Figure 12. A high-clearance flame cultivator particularly adaptable for late weed-control problems in tall cotton or corn.

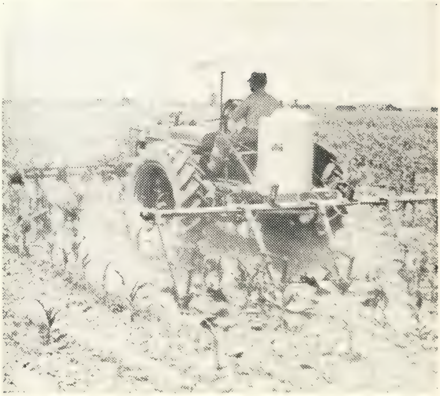

Figure 13. A flame cultivator in conjunction with conventional sweeps can be used effectively where a weed problem has developed.

BULLETIN 557 JANUARY 1958

Production and Marketing Practices of Cage and Floor Egg Producers in Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

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Summary and Conclusions

A study was made of 77 commercial table egg flocks (45 cage and 32 floor) for the purpose of comparing production and marketing practices of the two systems. Data for the period July 1, 1955, to June 30, 1956, were collected during the summer of 1956.

There has been an increase in the number and average size of commercial flocks (both cage and floor) in recent years. Cage flocks account for about 31 percent of the hens in commercial flocks.

A larger percentage of floor producers than cage producers reported that the egg enterprise or other farm enterprises was their main source of income. About one-fourth and one-half of the cage and floor producers, respectively, reported that the egg enterprise accounted for over 50 percent of their income.

In general, cage flocks were found on more highly specialized farms than were floor flocks. Cotton was grown by a larger proportion of cage than floor producers, but the average acreage was smaller for cage producers. Nearly one-half of the floor producers, in contrast to less than one-fifth of the cage producers, grew grain. A greater percentage of floor producers than cage producers kept beef and dairy animals, but generally kept fewer animals per farm.

The basic structure of cage-layer houses was similar to that of houses used for floor flocks. However, houses for floor flocks were generally wider than houses for cage flocks. Failure of most producers to fully utilize housing space resulted in a greater-than-recommended floor space per layer.

Cages were equipped to provide adequate water and feeder space per bird. A majority of the floor producers used hand feeders and waterers; 47 percent used automatic waterers. In all cases, feeder and waterer space per hen exceeded general recommendations.

All cage producers and nearly three-fourths of the floor producers reported use of artificial lights. Cage producers burned an average of 1.3 watts per hen per hour as compared to .6 watts per hen for floor producers.

A larger percentage of cage producers than of floor producers fed commercially mixed feed exclusively. A majority of the floor producers used a mash-grain feeding program, and bought feed of 20 percent or higher protein content. Almost all producers provided shell or limestone and over half provided grit for layers.

Colds or bronchitis, lucosis and fowl pox were the diseases reported as causing the most trouble in laying flocks. Colds or bronchitis and lucosis were more prevalent in cage flocks, and fowl pox was more prevalent in floor flocks. Nearly all producers vaccinated for fowl pox, and while most cage producers also inoculated against Newcastle disease, less than one-half of the floor producers did so.

Artificial methods of cooling laying houses were not used to a great extent by any producers.

Producers with cage flocks generally followed the practice of culling and replacing their laying flocks at regular intervals during the year. On the other hand, most producers with floor flocks culled and replaced a large part of their flocks only one time each year, usually in the late summer or early fall.

The annual average rate of lay for cage and floor flocks was 58 and 54 percent, respectively. Higher production in cage flocks was accounted for primarily by large flocks, since there was little difference in the rates of lay of cage and floor hens in small and medium flocks. The rate of lay was significantly higher and seasonality of production significantly less for cage flocks than for floor flocks.

The majority of floor producers gathered eggs much more often than did cage producers. Large producers gathered eggs more frequently than did small producers. Floor producers reported a higher proportion of dirty and cracked eggs than did cage producers. Little difference existed in the proportions of the two groups using different cleaning practices. Fifty-eight percent of the producers cleaned only dirty eggs, while 40 percent cleaned all eggs. One producer did not clean any eggs. The most common method of cleaning eggs was the use of a damp cloth or sponge.

Nearly three-fourths of the cage producers and over four-fifths of the floor producers sized eggs. In most instances, producers who did not size eggs were those with smaller flocks. Eggs were candled by over one-half of the cage producers but by less than one-third of the floor producers.

Nearly all producers delivered eggs to the buyer; however, cage producers generally delivered more frequently than did floor producers.

More producers sold eggs to retail grocery stores than to any other outlet. Over three-fifths of all eggs sold were sold to grocery stores.

The price received by a majority of producers was based on local supply and demand for eggs or on some central market price quotation. Retail grocery stores paid a greater premium for cage eggs than did any other outlet. The following practices and factors may have influenced the price differential between cage and floor eggs: (1) more frequent delivery by cage producers, (2) cage flocks were larger on the average than floor flocks, (3) cage producers followed more intensive advertising programs than did floor producers, and (4) cage producers had a more uniform supply of eggs for market throughout the year.

PRODUCTION AND MARKETING PRACTICES OF CAGE AND FLOOR EGG PRODUCERS IN MISSISSIPPI

By PAUL T. BLAIR and JOHN C. SIMS

Total table egg production in Mississippi has increased and the number of laying hens has decreased since the end of World War II, Table 1. The increase in production per layer has resulted from improved breeding, feeding, and related management practices.

The number of commercial laying flocks (200 hens and over) has increased in recent years. The total number of commercial flocks increased from 956 in 1953 to 1,181 in 1956, Table 2. Of this 225 flock increase, 40 were cage flocks and 185 were floor flocks. Cage flocks accounted for about 21 percent of all commercial egg flocks, both in 1953 and 1956.

Along with this increase in number of commercial flocks, the average size of flock has increased. The average size of cage flocks increased by 107 hens from 1953 to 1956 while that of floor flocks increased by only 31 hens. Cage flocks were larger than floor flocks in both years and accounted for about 31 percent of the commercial hens. Both cage and floor flocks were generally dispersed throughout the state.

The Problem

United States Department of Agriculture estimates indicate that consumption of eggs in Mississippi exceeds production by about 26 percent.[1] Yet Mississippi commercial egg producers have found it difficult in the past to dispose of their eggs at competitive or even lower prices because of their inability to guarantee (1) an adequate supply of eggs under past flock management practices and bird numbers, (2) a dependable seasonal distribution of egg supplies throughout the year so that handlers will not have to turn to other sources periodically, and (3) stability in the quality of their egg supplies.

Buyers serving Mississippi consumer outlets want arrangements with egg suppliers to meet their needs throughout the entire year. Consequently, seasonal surpluses of Mississippi eggs will not be taken by such buyers even at lower than prevailing prices. One of the largest buyers stated that his organization is ready to take Mississippi eggs when they can be obtained in car or truck-load lots and the supply of quality eggs can be depended on throughout the year. This is the hurdle to be cleared if the enterprise is to make a substantial contribution to the economy of the state.

Considerable economic research has been completed already at this station on sources of supplies and handling of eggs in the marketing practices between producers and retailers.[2] Since that work was done, there has been a sharp increase in emphasis on commercial egg production. Eggs sold increased by 23 percent from 1954 to 1955.[3] Substantial progress has been made in technical "know how". Commercial flocks are apparently larger; more emphasis is being placed on volume production; more mechanical processes are in evidence. The use of cages in addition to, or as a substitute for, conventional housing and handling methods is in process. These changes have been, or are being, adopted to correct previous weaknesses in marketing. It was highly desirable that our previous research be

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[1] United States Department of Agriculture, Agricultural Marketing Service, Statistical Bulletin Number 183, June, 1956. (Washington, D.C.) p. 19.

[2] **Marketing Procedures and Channels for Mississippi Eggs,** Mississippi Agricultural Experiment Station, Technical Bulletin No. 37, (State College, Mississippi, July, 1953).

[3] **Basebook of Mississippi Agriculture, 1866-1953, Supplement No. 1.** (Jackson, Mississippi, 1955) p. 25.

Table 1. Number of laying hens, eggs produced per layer, and total eggs produced, Mississippi, 1945-1954.

Year	Number of laying hens (thousand)	Eggs produced per layer	Total eggs produced (million)
1945	5,932	103	611
1946	5,610	105	589
1947	5,162	111	573
1948	4,930	115	567
1949	5,177	124	642
1950	5,354	127	680
1951	4,771	131	625
1952	4,880	133	649
1953	4,915	142	698
1954	4,874	143	697

Source: **Basebook of Mississippi Agriculture, 1866-1953, Supplement No. 1.** (Jackson, Mississippi, 1955), p. 25.

Table 2. Number of commercial table egg flocks, by type of flock, Mississippi, 1953 and 1956.[1]

Item	Type of flock					
	Cage		Floor		All flocks	
	1953	1956	1953	1956	1953	1956
Total number of flocks	206	246	750	935	956	1,181
Change from 1953		40		185		225
Total number of hens (1000)	169	228	380	502	549	730
Change from 1953		59		122		181
Average number of hens per flock	819	926	506	537	573	618
Change from 1953		107		31		45

Source: Compiled from survey data collected from county agents in 1953 and 1956.

[1] Laying flocks of 200 hens or more are classified as commercial flocks.

supplemented by a study of these new developments.

Objectives

The specific objectives of this study were:

1. To describe the general characteristics of farms producing commercial table eggs in Mississippi and to describe poultry management practices on these farms.
2. To determine the effect of changing poultry management practices on total production, seasonality of production and quality of commercial eggs produced in Mississippi.
3. To analyze present and to indicate potential effects of the new developments on supplies and subsequent impacts on market outlets and prices.

Method and Procedure

Data on the number and size of commercial table egg flocks in Mississippi were obtained from all County Extension Agents in the state by mail questionnaires in early 1956. Data collected included the number of cage and floor flocks in the following size groups: 200-399 hens, 400-599, 600-999, 1000-1499 and 1500, and up.

A total of 12 cage producers was selected at random from each size group listed above. An attempt was made to match each cage flock with the nearest floor flock in the same size group.

Original intentions of obtaining data from 60 cage and 60 floor producers were altered because of the time element involved and limited personnel for field work. Data were obtained from 45 cage and 32 floor producers during the summer of 1956.

This limited amount of data necessitated a re-grouping of the schedules taken into the following size groups: 200-499 hens, 500-999, and 1000-up.[4]

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[4] Throughout this study these size groups are referred to as small, medium and large, respectively.

General Characteristics of Commercial Poultry Farms In Mississippi

In general, floor flocks were associated with diversified farming operations, whereas a majority of cage flocks were located on more specialized farms. Also a larger percentage of cage producers than of floor producers obtained a substantial portion of their income from nonfarm sources.

Importance of the Commercial Egg Enterprise as a Source of Income

Forty-one percent of the floor producers reported that the egg enterprise provided the main source of income as compared to 36 percent of the cage producers, Table 3. Other farm enterprises were the main source of income for 33 percent of the cage producers and 43 percent of the floor producers.

Thirty-one percent of the cage producers reported that their main source of income was of nonfarm origin as compared to 16 percent of the floor producers. Cage and floor producers with small and medium flocks relied more on nonfarm income than did producers with large flocks.

Percent of Income From Commercial Egg Enterprise

The commercial egg enterprise was a relatively unimportant source of income on 16 percent of the farms with cage flocks and 12 percent of the farms with floor flocks, Table 4. On the other hand, the poultry enterprise accounted for one half or more of the producers' income on one-fourth of the farms with cage flocks and almost one-half of the farms with floor flocks.

Size of Farm

In general, the smaller commercial egg enterprises were located on the larger farms, whereas the larger commercial egg enterprises were located on smaller farms, Appendix Table 1. This was true for both cage and floor flocks. The average size of farms with cage and floor

Table 3. Main source of income of commercial table egg producers, by size and type of flock, 77 producers, Mississippi, 1955-1956.

Main source of income	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Commercial egg enterprise	36	58	38	29	33	29	36	41
Other farm enterprises	18	21	29	57	57	62	33	43
Nonfarm	46	21	33	14	10	9	31	16
Total	100	100	100	100	100	100	100	100

Table 4. Percentage of producers' income derived from the commercial egg enterprise, by size and type of flock, 77 commercial egg producers, Mississippi, 1955-1956.

Percentage of producers' income from commercial egg enterprise	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percentage of producers reporting)							
Less than 10	22	21	23	10	----	----	16	12
10-24	45	36	8	20	29	----	29	22
25-49	33	36	46	----	14	25	31	22
50-74	----	7	23	30	7	38	9	22
75 and over	----	----	----	40	50	37	15	22
Totals	100	100	100	100	100	100	100	100

Table 5. Percentage of flocks established in specified years, by size and type of flock, 77 flocks, Mississippi.

Year in which flock was established.	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percentage of producers reporting)							
Before 1950	------	36	------	50	7	62	2	47
1950	------	------	------	30	7	13	2	13
1951	------	------	15	------	7	------	7	0
1952	6	29	------	------	0	13	2	16
1953	22	7	62	10	21	12	33	9
1954	61	14	15	10	29	------	38	9
1955	11	14	8	------	29	------	16	6
Totals	100	100	100	100	100	100	100	100

Table 6. Average size of flock when established and in 1956 and change in flock size from establishment to 1956, by size and type of flock, 77 flocks, Mississippi.

Item	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
Average size of flock:	(Number of hens)							
When established	432	282	710	415	1,304	584	784	399
In 1956	355	311	781	741	1,714	1,721	901	798
	(Percent)							
Size in 1956 as percent of size when esstablished	82	110	110	178	131	294	115	200

flocks was 192 and 149 acres, respectively.

Crop and Livestock Enterprises

A larger proportion of producers with cage flocks produced cotton than did producers with floor flocks; however, the average cotton acreage per farm was smaller for cage producers, Appendix Table 1. Cage and floor producers with medium flocks reported a much smaller cotton acreage than did the small and large producers. Forty-four percent and 18 percent of the floor and cage producers, respectively, reported growing some type of grain. The average acreage grown by cage producers was 33 and by floor producers, 16.

A higher percentage of floor producers kept beef and dairy animals than did cage producers but generally kept fewer animals per farm, Appendix Table 1. One-fourth of the cage producers and one-half of the floor producers reported beef cattle. The average number kept was 41 head and 25 head, respectively, for cage and floor producers. Thirty-six and 62 percent, respectively, of cage and floor producers kept dairy cows. The average size of herd was significantly larger on farms with cage flocks. Hogs were found more commonly on farms with floor flocks and the average number per farm was much higher than the average number on farms with cage flocks.

Year Flocks Established and the Increase or Decrease in Size

The use of cages for the production of commercial table eggs is relatively new in Mississippi. Ninety-eight percent of the cage operations studied were established after 1950, with 33 percent being established in 1953 and 38 percent in 1954, Table 5. Sixty percent of all floor flocks studied were established prior to 1951.

The average size of medium and large cage flocks and of all floor flocks has increased since the flocks were established, Table 6. The greatest increase occurred in large cage and floor flocks, 31 and 194 percent, respectively. In each size group, the average cage flocks were larger than the average floor flocks both when established and in 1955.

Production Practices

Size of Houses

The basic structure of cage-layer houses is similar to that of houses used for floor flocks. All cage and floor commercial egg farms visited used single-story houses. All houses used for floor flocks and a majority of those used for cage flocks had all dirt floors. A few cage houses had dirt floors with concrete walks. Cage houses ranged from 7 to 35 feet wide with 70 percent being between 20 and 29 feet wide, Table 7. Floor houses ranged from 10 to 50 feet wide with 52 percent being over 30 feet wide and about 22 percent less than 20 feet wide.

Cage houses less than 20 feet wide had two rows of single cages placed back to back, and houses 20-29 feet wide usually had six rows of single cages placed back to back.

Feeder, Water and Floor Space Per Bird

The Poultry Department of Mississippi State College recommends that each hen be allowed a minium of three linear inches of feeder space, one-half linear inch of waterer space,[5] three to four square feet of floor space[6] and one watt of light per working period (13 to 14 hours daily).[7]

Practically all cage operations studied used "V" trough continuous waterers placed between cages so that the hens in two rows had access to the same water trough. Forty-seven percent of the producers with floor flocks reported using automatic pan or trough waterers. The remainder watered by hand. Both cage and floor producers in all size groups provided more than the recommended amount of watering space, Appendix Table 2.

Feed was provided for hens in cages in feed troughs attached to the outside of the cage opposite the water trough. Producers with floor flocks generally used metal or wooden trough hand feeders and provided more feed space per hen than recommended.

The average amount of floor space provided by all producers in all size groups, was generally greater than the recommended amount. In cage and floor flocks, the space allowed per hen decreased as the size of flock increased.[8] Feeder and waterer space per hen was the same for cage flocks regardless of the size of flocks because of the way the cage is designed and equipped.

Lighting Program

All cage producers and 72 percent of floor producers reported use of artificial light. A larger proportion of floor producers with large flocks burned lights than did those with small flocks, Appendix Table 3. Cage producers burned an average of 1.3 watts per hen compared to .6 watts per hen for floor producers. Floor flock producers used less wattage per hen in large flocks than in small flocks.

Feeding Practices

A larger percentage of cage producers than of floor producers fed commercially mixed feeds exclusively. Less than 20 percent of the cage producers and almost three-fourths of the floor producers fed grain in addition to commercialy mixed feed, Appendix Table 4. Over one-half

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[5] Equivalent to a minimum of five four-feet automatic waterers per 1,000 birds.

[6] Light breed hens require from 3 to 3 1/2 square feet per hen and heavy breed require 3 1/2 to 4 square feet.

[7] Light should be supplied by 45 or 60 watt bulbs only.

[8] Floor space per hen in cage operations is influenced by the extent of the utilization of cages to capacity.

Table 7. Percentage of producers with poultry houses of specified width by type of flock, 77 producers, Mississippi, 1956.

Item	Type of house	
	Cage	Floor
	(Percent of producers)	
Width of house in feet:		
Less than 20	14	22
20-29	70	26
30 and over	16	52
Total	100	100

Table 8. Frequency of culling by commercial egg producers, by type of flock, 77 flocks, Mississippi, 1955-1956.

Item	Type of flock	
	Cage	Floor
	(Percent of producers)	
Frequency of culling:		
Continuously	25	25
Every week	13	0
Every two weeks	20	3
Every month	18	0
One time per year	2	34
No regular time	22	38
Total	100	100

of the floor producers bought feed of 20 percent or higher protein content. Over 94 percent of the producers interviewed provided shell or limestone and over 50 percent provided grit for layers.

Disease Control

About one-third of the cage producers and one-fourth of the floor producers reported some disease during the previous year, Appendix Table 5. Disease was more prevalent in cage flocks than in floor flocks. Of the cage producers reporting disease problems, 64 percent indicated either colds or bronchitis as the major disease, 29 percent cited lucosis and the remainder reported a combination of diseases. Of the floor producers reporting disease, 38 percent reported colds or bronchitis as the major disease, 24 percent reported fowl pox or sore-head and 38 percent reported a combination of diseases.

All but one cage producer and 78 percent of all floor producers vaccinated for fowl pox. Vaccination was usually done at 8 to 12 weeks of age by both cage and floor producers.

Sixty-nine percent of cage producers compared to only 44 percent of floor producers vaccinated for Newcastle. Of the cage producers who vaccinated, 61 percent reported that they vaccinated two times, whereas ony 36 percent of the floor producers vaccinated twice.[9] Practically all of those who vaccinated twice, vaccinated the first time when the chicks were from 1 to 7 days old and the second time at 12 to 16 weeks.

Producers generally followed sanitary practices in disposing of dead birds. Seventy-three percent of the cage producers and 62 percent of the floor producers disposed of dead birds by either burying, burning or depositing in covered disposal pits, Appendix Table 6.

Cooling Houses by Artificial Methods

Artificial methods of cooling laying houses were not used to a great extent by either cage or floor producers. Only 4 cage producers and 2 floor producers reported artificial cooling. None of the producers with large flocks cooled the laying house by artificial methods.

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[9] This does not include chicks that might have been vaccinated before the producer got them.

Culling and Replacement Practices

Frequency of culling. Seventy-six per cent of the cage producers interviewed reported that they culled either continuously or followed a regular practice of culling weekly, every two weeks or monthly, Table 8.

Only 28 percent of the floor producers used these same practices. On the other hand, 72 percent of the floor producers either culled one time each year or had no regular time of culling.

One of the main advantages ascribed to the cage operation is the ease with which nonproductive hens can be determined. Each layers' eggs are gathered separately, and it is easy to determine the rate of lay for individual hens.

Most of the cage producers reported that they culled whenever a hen fell below 50 percent production over a two-week or longer period. The length of time usually depended on the prices of eggs and cull hens and the availability of replacements. Some producers kept a hen in the cage as long as she appeared to be in good condition, even though her rate of production might be below 50 percent. Producers with floor flocks who culled continuously or at regular intervals usually determined which birds to cull by the general appearance, pigmentation and other physical characteristics of nonlayers.

Monthly distribution of culling and replacement. Culling of cage flocks varied less from month-to-month than did culling of floor flocks. Except in July, between 7 and 11 percent of the total number of birds culled from cage flocks were culled each month, Appendix Table 7. Conversely, culling of floor flocks was highly seasonal with 45 percent of the annual cull being made in November, December and January.

Replacement of hens culled from cage flocks also varied less from month-to-month than did replacement of hens culled from floor flocks. Generally, hens culled from floor flocks were replaced once each year and those from cage flocks several times during the year, Appendix Table 8. Some replacements were added to cage flocks each month; however, 28 percent was added in August and September, 23 percent from November through January and 36 percent from March through June.

Production Relationships

Profits received from commercial egg production are influenced by many factors,, one of the more important being rate of lay. Rate of lay is important both to production and marketing of eggs. A higher rate of lay tends to increase net returns to the operator and facilitate the marketing of eggs in a more efficient manner, especially if the higher rate of lay is not subject to marked seasonal variation.

Average Rate of Lay

The average rate of lay per hen, calculated on a per flock basis, is shown in Appendix Table 9. There was no significant differences in the monthly rate of production between small cage and floor flocks, nor between medium cage and floor flocks.[10] However, the rate of production was significantly higher for large cage flocks than for large floor flocks when tested at the 1 percent level.

Seasonality of Production

Seasonality of production, as well as the average annual rate of production, has an influence on the marketing of eggs. One of the primary complaints of market outlets for Mississippi eggs has to do with the large variation in seasonal supplies.

For small flocks there was no significant difference in the rate of production between cage and floor flocks; however, the seasonality of production was significantly greater in floor flocks than in cage flocks. For the medium sized flocks, there was no significant difference in either the rate of lay or seasonality of production between cage and floor flocks. For large flocks, the rate of lay was significantly higher and the seasonality of production was significantly lower for cage flocks than for floor flocks.

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[10] $F = 0.362$ and 0.062 for small and medium flocks, respectively. See Appendix Table 10 for Analysis of Variance results for each size group.

There was little difference in the rate of lay between different size cage flocks. The rate of lay in large floor flocks was substantialy lower than in small and medium floor flocks. This was probably due to the greater competition among birds in the large floor flocks.

Marketing Practices

Practices used by producers in handling eggs have a decided effect on the quality of the eggs that they sell. Some poultrymen believe that the cage system of producing eggs has advantages over the floor system in preparing eggs for market. Two advantages claimed are that eggs cool faster in cages than in nests and fewer dirty eggs are gathered if the floors of the cages are kept clean.

Preparation of Eggs for Market

Gathering eggs. The majority of cage producers gathered eggs only one time per day, whereas most floor producers gathered eggs three times or more per day, Table 9. There was little variation in the number of times per day that eggs were gathered in summer and winter. Producers with large flocks gathered eggs more frequently than did those with small and medium flocks. The main reasons given by cage producers for not gathering eggs more frequently were that little breakage occurred and that cage eggs cool rapidly after being laid.

Floor producers averaged a higher proportion of dirty eggs than did cage producers. Dirty eggs averaged 16 percent of total production of floor flocks and 7 percent of that of cage flocks, Appendix Table 11. This does not differ appreciably from results obtained from experimental test flocks at Mississippi State College, Appendix Table 12.

Cage and floor producers, respectively, reported that 3.0 and 3.5 percent of all eggs produced were cracked. Experimental results from the Poultry Department at Mississippi State College are not available for comparison.

Table 9. Proportion of producers gathering eggs specified number of times, by seasons, by size and type of flock, 77 flocks, Mississippi, 1955-56.

Frequency of gathering	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Summer:								
Once daily	61	7	85	20	43	.....	62	9
Twice daily	33	21	15	20	29	12	27	19
Three or more times daily	6	72	--	60	28	88	11	72
Total	100	100	100	100	100	100	100	100
Winter:								
Once daily	72	7	85	20	43	......	67	9
Twice daily	22	29	15	20	29	12	22	22
Three or more times daily	6	64	......	60	28	88	11	69
Total	100	100	100	100	100	100	100	100

Cleaning practices. All producers reported having some dirty eggs. Fifty-six percent of all cage producers and 62 per cent of all floor producers cleaned only the dirty eggs, whereas 42 and 38 percent of all cage and floor producers, respectively, cleaned all eggs. One of the small producers did not clean eggs.

Most producers reported that they cleaned eggs with a damp cloth or sponge. Other producers reported that they either dry cleaned eggs, washed by hand or used a mechanical washer, Table 10.

Sizing eggs. Producers who sized eggs used various means. A few reported that they merely separated the large eggs from the small by hand. Other producers either used small hand scales or automatic sizing equipment. Seventy-three percent of the cage producers and 81 percent of the floor producers sized eggs, Appendix Table 14. The practice of sizing eggs was more commonly reported by cage and floor producers with large and medium flocks than by those with small flocks.

Candling eggs. Fifty-three percent of the cage producers and only 28 percent of the floor producers candled eggs on the farm to remove eggs containing meat or blood spots, Appendix Table 14. A larger proportion of cage producers than of floor producers in all size groups candled eggs. A greater proportion of large producers than of small and medium producers candled eggs.

Packing and storing eggs prior to marketing. Sixty-seven percent of the cage producers and 94 percent of the floor

Table 10. Proportion of producers cleaning eggs and following selected cleaning methods, by type of flock, 77 flocks, Mississippi, 1955-56.

Item	Type of flock	
	Cage	Floor
	(Percent of producers)	
Cleaning practices:		
Cleaned all eggs	42	38
Cleaned dirty eggs only	56	62
Did not clean	2	------
Total	100	100
Methods of cleaning:		
Damp cloth or sponge	56	44
Hand washed	11	34
Dry cleaned[1]	20	19
Mechanical washer	11	3
Did not clean	2	----
Total	100	100

[1] Includes eggs cleaned with steel wool, sandpaper, or brush.

Table 11. Proportion of producers selling eggs with specified frequency, by size and type of flock, 77 flocks, Mississippi, 1955-1956.

Frequency	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Once per week	17	57	8	30	14	-----	13	34
Twice per week	22	29	23	60	7	50	18	44
Three times or more per week[1]	61	14	69	10	79	50	69	22
Total	100	100	100	100	100	100	100	100

[1] Five producers with cage flocks and 2 with floor flocks made deliveries on call in addition to regular deliveries.

producers reported that they packed eggs the same day that they were gathered, Appendix Table 15. Most producers kept eggs either in unrefrigerated egg rooms, in their dwelling houses or in cellars prior to marketing. Only 13 percent of the cage producers and 6 percent of the floor producers reported having refrigeration equipment for cooling eggs. A few producers kept eggs in air-conditioned rooms.

Selling Eggs

Practically all producers reported that they had some kind of verbal selling agreement with egg buyers. One cage producer and one floor producer reported having written contracts.

Most producers followed the practice of delivering eggs. However, a few producers reported that all eggs were sold at the farm, either to individual consumers, to an egg dealer, or both.

Frequency of selling eggs. Cage producers marketed their eggs more frequently than did floor producers, Table 11. Sixty-nine percent of the cage producers marketed their eggs three or more times per week as compared to only 22 percent of the floor producers. Producers with large flocks marketed their eggs more frequently than did producers with small and medium flocks.

Market outlets. More producers sold eggs to retail grocery stores than to other outlets, Table 12. Other outlets were institutions, egg dealers, retail routes, home sales and miscellaneous. Retail grocery stores not only were the outlet for a majority of the producers, but also handled a majority of the eggs sold.

Thirty-one percent of the cage producers and 47 percent of the floor producers sold eggs through only one outlet, Appendix Table 17. Forty percent of the cage producers and 31 percent of the floor producers utilized two market outlets. Twenty-nine percent of the cage producers and 22 percent of the floor producers sold eggs through three or more outlets. Three or more market outlets were used more frequently by large and medium flock owners than by small flock owners.

Identifying and advertising eggs. The majority of producers sold eggs in one dozen cartons and/or 30-dozen cases. Of the cage producers who sold eggs in cartons, 44 percent reported that they either used a special carton with a printed brand name or identified the carton by use of a rubber stamp, Appendix Table 18. Only 16 percent of the floor producers who sold eggs in cartons followed this practice. Other producers who sold eggs in cartons used either plain cartons or cartons which signified a brand of feed.

In addition to identifying egg cartons, 13 percent of the cage producers advertised their eggs in local newspapers. None of the floor producers interviewed ad-

Table 12. **Proportion of producers selling eggs to various outlets and proportions of eggs sold to various outlets, by type of flock, 77 flocks, Mississippi, 1955-56.**

	Type of flock			
	Cage		Floor	
Outlet	Producers	Eggs	Producers	Eggs
	(Percent)			
Retail grocery store	76	62	59	61
Institutions	33	12	18	7
Egg dealers	29	13	25	12
Retail route	11	6	28	9
Home sales	38	1	28	5
Miscellaneous[1]	29	6	16	6
Total		100		100

Source: Appendix Table 16.

[1] Miscellaneous outlets include cooperatives, bakeries, creameries and food manufacturers.

vertised their eggs by this means. The majority of the cage producers who advertised had large flocks.

Basis for pricing eggs. More cage producers participated in price formation than did floor producers. Seventy one percent of the cage producers as compared to 59 percent of the floor producers reported that the price they received for eggs was either their quoted price or a price determined by bargaining, Appendix Table 19. Twenty-nine percent of the cage producers and 41 percent of the floor producers stated that the buyer alone determined the price received for eggs.

Prices received by a majority of the producers were usually based on local supply and demand conditions or on some central market quotations, Table 13. A few producers reported that they received one price for eggs the year-round.

Average price received for sized eggs. Monthly and annual weighted average prices for cage and floor eggs varied

Table 13. Proportion of producers specifying bases of prices received for eggs, by type of flocks, 77 flocks, Mississippi, 1955-1956.

Basis of pricing	Type of flock	
	Cage	Floor
	(Percent of producers)	
Premium over local prices	8	3
Allow retailer a certain markup	2	6
One price the year round	15	13
Local supply and demand	33	53
Jackson Central Market quotation	29	16
Market quotations in adjoining states[1]	4	6
Market quotations from other Central markets[2]	9	3
Total	100	100

Source: Appendix Table 19.

[1] Includes markets in New Orleans, Memphis, and Mobile.

[2] Includes markets in New York and Chicago.

Table 14. Average prices[1] received for sized eggs and floor eggs, by type of outlet, by month, 23 cage producers and 15 floor producers, Mississippi, July, 1955-June, 1956.

Outlet and type of eggs	Month												
	Ju.	A	S	O	N	D	J	F	M	A	M	J	Year
	(Cents per dozen)												
Grocery stores:													
Cage eggs	60	60	56	57	59	62	63	59	54	53	50	53	57
Floor eggs	48	48	49	52	55	56	54	48	44	42	42	45	48
Retail Routes:													
Cage eggs	51	51	52	53	60	59	59	58	59	56	57	57	55
Floor eggs	58	54	56	58	60	62	63	62	60	54	53	54	58
Home Sales:													
Cage eggs	53	53	57	55	58	58	58	54	54	52	51	51	54
Floor eggs	54	54	55	58	59	62	59	55	53	48	49	53	56
Institutions:													
Cage eggs	52	54	55	55	56	57	57	53	56	50	47	48	53
Floor eggs	49	48	52	52	53	51	54	51	50	48	48	48	50
Egg dealers:													
Cage eggs	44	46	48	49	53	55	50	50	46	44	42	41	47
Floor eggs	42	44	45	48	51	52	52	46	42	41	40	43	45
Miscellaneous:													
Cage eggs	40	44	41	48	43	46	43	40	35	35	34	34	39
Floor eggs	38	40	45	49	49	53	54	53	49	46	46	42	47

[1] Weighted average price received for eggs was computed as follows: Total receipts from eggs sold to various outlets ÷ total number of dozen sold to various outlets = average price.

considerably between various outlets, Table 14. The difference between the price of cage eggs and the price of floor eggs sold to grocery stores is especially significant; taking into account that over 60 percent of cage and floor eggs were sold through this type of outlet. The average price received by cage producers selling to grocery stores was 9 cents per dozen higher than that received by floor producers. The following practices and factors may have influenced he price differential between cage and floor eggs: (1) more frequent delivery by cage producers, (2) cage flocks were larger on the average than floor flocks, (3) cage producers followed more intensive advertising programs than did floor producers, and (4) cage producers had a more uniform supply of eggs for market through out the year.

Although cage producers received an annual average price of 57 cents per dozen for eggs sold to grocery stores compared with 48 cents received by floor producers, it should be kept in mind that this is a gross rather than net price differential. Since cage producers delivered more frequently and generally had more advertising expense, the difference in net price per dozen received by cage and floor producers may have been considerably less than the gross price differential.

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Appendix Tables

Appendix Table 1. General characteristics of commercial poultry farms by size and type of flock, 77 producers, Mississippi, 1955-1956.

	Size and type of flock							
	Small		Medium		Large		All sizes	
Item	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
Average size of farms (acres)	200	247	236	74	141	70	192	149
				(Percent)				
Percent of farms reporting:								
Cotton	56	43	38	20	29	25	42	31
Grain	11	64	23	30	21	25	18	44
Beef cows	39	64	23	30	14	50	27	50
Dairy cows	39	57	31	60	36	75	36	62
Hogs	22	64	31	10	14	62	22	47
Sheep	6	------	------	------	------	12	2	3
				(Number)				
Average per farm:								
Cotton (acres)	10	10	4	3	15	37	10	14
Grain (acres)	4	9	8	28	77	29	33	16
Beef cows (head)	29	31	79	13	24	20	41	25
Dairy cows (head)	23	12	32	8	54	5	35	9
Hogs (head)	12	35	3	65	9	5	8	27
Sheep (head	6	------	------	------	------	60	6	60

Appendix Table 2. Average floor space, feeder space and water space per hen provided by commercial egg producers, by size and type of flock, 77 flocks, Mississippi, 1955-1956.

	Size and type of flock							
	Small		Medium		Large		All sizes	
Space per hen	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
Floor (sq. feet)	5.2	5.7	4.9	4.3	3.9	4.0	4.3	4.4
Feeder (inches)	10.0[1]	5.5	10.0	4.1	10.0	4.1	10.0	4.2
Water (inches)	3.0[2]	2.3	3.0	1.6	3.0	1.9	3.0	2.0

[1] Cages are normally 8 or 10 inches wide and provide 8 or 10 inches of feeder space. All except two producers reporting had 10 inch cages.

[2] Cages are designed with an opening to provide about three inches of water space per bird.

Appendix Table 3. Lighting practices used by commercial egg producers, by size and type of flock, 77 producers, Mississippi 1955-1956.

	Size and type of flock							
	Small		Medium		Large		All sizes	
Item	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
Percent of producers:								
Burned lights	100	57	100	80	100	88	100	72
Did not burn lights	0	43	0	20	0	12	0	28
Total	100	100	100	100	100	100	100	100
Average number hens per light	33	62	36	57	38	73	30	72
Average watts per hen	1.2	.8	1.3	.7	1.3	.5	1.3	.6
Number of hours of light (daylight and artificial)[1]								
13-14 hrs.	6	0	16	0	0	25	7	9
14-15 hrs	33	63	38	38	50	38[2]	40	48[2]
15-16 hrs.	17	12	0	25	14	25	11	22
16 and over	33	0	46	0	29	0	35	0
All night lights	11	25	0	37	7	25[2]	7	30[2]
Totals	100	100	100	100	100	113	100	109
When lights were burned:								
A.M.	28	25	31	50	50	88[2]	36	61[2]
P.M.	28	38	15	13	14	0	20	9
A.M. and P.M.	33	12	54	0	29	0	38	9
All night	11	25	0	37	7	25[2]	6	30[2]
Totals	100	100	100	100	100	113	100	109

[1] Producers reported that artificial lights were used in order to supplement daylight hours to maintain a cerain number of hours of light per day.

[2] Twenty-fve percent of the floor producers reported that they burned lights all night on old hens in addition to maintaining 14-15 hours of total light on the other hens.

Appendix Table 4. Feeds fed by commercial egg producers, by size and type of flock, 77 producers, Mississippi, 1955-1956.

	Size and type of flock							
	Small		Medium		Large		All sizes	
Item	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Type of feed used:								
Mash	11	21	8	10	7	25	9	19
Pellets or crumbles	78	14	61	0	79	12	73	9
Grain and mash	11	65	31	90	14	63	18	72
Total	100	100	100	100	100	100	100	100
Shell	100	93	100	90	100	100	100	94
Grit	39	50	80	80	23	89	51	69
Protein content of mixed feed purchased (percent)								
15-16	56	14	31	20	29	13	40	16
17-18	44	29	54	0	57	13	51	16
20-21	0	36	0	70	0	63	0	53
Over 21	0	0	0	10	0	21	0	6
Didn't know	0	21	15	0	14	0	9	9
Total	100	100	100	100	100	100	100	100

Appendix Table 5. **Percentage of producers reporting disease causing the most trouble and disease vaccinated against, by type of flocks, 77 flocks, Mississippi, 1955-1956.**

Item	Type of flock	
	Cage	Floor
	(Percent of producers)	
Reporting disease	31	25
Reporting no disease	69	75
Total	100	100
	(Percent of producers reporting specific diseases)	
Diseases reported as the major problem:		
Cold or bronchitis	64	38
Lucosis	29	0
Fowl pox or sore-head	0	24
Combination of diseases	7	38
Total	100	100
	(Percent of producers)	
Diseases vaccinated against:		
Fowl pox	98	78
Newcastle and bronchitis[1]	69	44
	(Percent of producers who vaccinated)	
Number of vaccinations against Newcastle[2]		
One	39	64
Two	61	36
Total	100	100

[1] Normally, a combination vaccine is used against these diseases.

[2] Excluding dealer vaccinations.

Appendix Table 6. **Methods used by commercial egg producers to dispose of dead birds, by size and type of flock, 77 producers, Mississippi, 1955-1956.**

Method of disposal	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Bury	28	36	31	20	29	25	28	28
Burn	33	14	15	30	29	51	27	28
Disposal pit	11		23	10	21	12	18	6
Other	28	50	31	40	21	12	27	38
Total	100	100	100	100	100	100	100	100

Appendix Table 7. Distribution of annual cull, commercial egg flocks, by months,[1] by size and type of flock, 76 flocks, Mississippi, July, 1955-June, 1956.

Size and type of flock	Month												
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
	(Percent of annual cull)												
Small:[2]													
Cage	4.6	5.9	16.6	9.8	11.3	6.2	9.8	11.2	9.6	4.4	6.2	4.4	100.0
Floor	2.8	5.7	18.1	4.7	9.4	11.9	7.1	21.2	4.5	5.1	4.5	5.0	100.0
Medium:[3]													
Cage	2.4	5.3	12.8	8.9	10.3	10.4	7.1	6.6	11.2	7.9	11.0	6.1	100.0
Floor	2.8	5.9	16.6	14.3	10.0	14.1	5.8	5.2	13.0	5.9	3.4	3.0	100.0
Large:[4]													
Cage	4.3	11.9	8.1	7.4	8.7	9.3	8.1	7.9	9.7	8.5	8.3	7.8	100.0
Floor	4.4	7.8	4.3	2.5	15.7	22.8	25.5	2.8	3.2	2.2	5.9	2.9	100.0
All sizes:[5]													
Cage	3.8	8.8	11.1	8.3	9.7	9.0	8.2	8.2	10.1	7.5	8.7	6.6	100.0
Floor	3.6	6.8	11.0	6.6	12.7	17.9	15.6	7.2	6.6	3.9	4.8	3.3	100.0

[1] Includes layers that died.

[2] Based on 18 cage schedules for each month except as follows: 12 in July, 17 in Aug., and 16 in June. Based on 14 floor schedules for each month except as follows: 8 in July, 13 in Aug., and 13 in June.

[3] Based on 13 cage schedules for each month except as follows: 9 in July, and 11 in June. Based on 10 floor schedules for each month except as follows: 7 in July, 9 in May, and 8 in June.

[4] Based on 13 cage schedules for each month except as follows: 9 in July, 12 in Aug., and 9 in June. Based on 8 floor schedules for each month except as follows: 6 in June.

[5] Based on 44 cage schedules for each month except as follows: 30 in July, 42 in Aug., and 36 in June. Based on 32 floor schedules for each month except as follows, 23 in July, 31 in Aug., 31 in May, and 27 in June.

Appendix Table 8. **Distribution of annual replacements, by size and type of flock, 76 commercial egg flocks, Mississippi, July, 1955-June, 1956.**

Size and type of flock	Month												
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
	(Percent of annual replacement)												
Small:[1]													
Cage	9.0	13.0	15.6	9.9	5.4	7.1	5.4	4.4	13.0	4.8	5.3	7.1	100.0
Floor	---	11.3	37.1	---	---	1.1	4.1	---	21.7	1.9	5.9	16.9	100.0
Medium:[2]													
Cage	7.1	9.6	16.2	1.6	7.7	2.8	13.8	---	11.6	5.2	12.8	11.6	100.0
Floor	12.4	29.4	29.8	7.1	---	4.4	---	---	5.9	11.0	---	---	100.0
Large:[3]													
Cage	.3	15.0	14.9	6.0	6.8	13.6	3.4	5.2	7.7	15.7	3.7	7.7	100.0
Floor	35.7	3.9	15.7	4.1	---	1.0	---	---	20.5	---	18.4	.7	100.0
All sizes:[4]													
Cage	4.2	12.9	15.4	5.4	6.8	9.0	7.0	3.5	10.0	10.2	6.8	8.8	100.0
Floor	24.5	12.1	22.5	4.4	---	2.0	.5		16.5	3.4	11.5	2.6	100.0

[1] Based on 18 cage schedules for each month except as follows: 12 in July, 17 in Aug., and 16 in June. Baased on 14 floor schedules for each month except as follows: 8 in July, 13 in Aug., and 13 in June.

[2] Based on 13 cage schedules for each month except as follows: 9 in July, and 11 in June. Based on 10 floor schedules for each month except as follows: 7 in July, 9 in May, and 8 in June.

[3] Based on 13 cage schedules for each month except as follows: 9 in July, 12 in Aug., and 9 in June. Based on 8 floor schedules for each month except as follows: 6 in June.

[4] Based on 44 cage schedules for each month except as follows: 30 in July, 42 in Aug., and 36 in June. Based on 32 floor schedules for each month except as follows: 23 in July, 31 in Aug., 31 in May and 27 in June.

Appendix Table 9. Average monthly rate of lay per hen calculated on a flock basis adjusted to 30-day months, by size and type of flock, Mississippi, July, 1955-June, 1956.

	Size and type of flock							
	Small		Medium		Large		All sizes	
Month	Floor	Cage	Floor	Cage	Floor	Cage	Floor	Cage
	(Dozen)							
July	1.157	1.500	1.507	1.303	1.141	1.382	1.346	1.463
August	1.184	1.379	1.369	1.390	1.181	1.423	1.304	1.442
September	1.440	1.435	1.347	1.311	1.310	1.519	1.369	1.431
October	1.306	1.436	1.480	1.315	1.092	1.571	1.374	1.497
November	1.421	1.347	1.400	1.375	1.288	1.534	1.380	1.412
December	1.426	1.327	1.330	1.417	1.170	1.467	1.368	1.438
January	1.571	1.424	1.409	1.413	1.176	1.477	1.454	1.485
February	1.751	1.560	1.523	1.492	1.527	1.560	1.546	1.492
March	1.841	1.540	1.598	1.611	1.386	1.464	1.682	1.585
April	1.603	1.583	1.389	1.645	1.303	1.323	1.440	1.517
May	1.589	1.449	1.302	1.500	1.374	1.379	1.462	1.487
June	1.404	1.342	1.555	1.309	1.291	1.454	1.442	1.368
No. flocks	(7)	(13)	(9)	(7)	(5)	(9)	(21)	(29)

Appendix Table 10. Analysis of variance of differences in weighted average production per flock, by type and size of flock adjusted to 30-day months, Mississippi, July, 1955-June, 1956.[1]

Source of variation	Degrees of freedom	Sum of squares	Mean squares
Small Flocks:			
Total	23	.563831	
Between types	1	.005735	.005735
Between months	11	.383627	
Residual	11	.174470	.015860
F = .005735/.015860 = .362			
Medium Flocks:			
Total	23	.251875	
Between types	1	.000683	.000683
Between months	11	.028988	
Residual	11	.129288	.011029
F = .000683/.011029 = .062			
Large Flocks:			
Total	23	.456326	
Between types	1	.223108	.223108
Between months	11	.124696	
Residual	11	.108522	.009865
F = .223108/.009865 = 22.616117[2]			

[1] The "F" tests in this table are only approximate tests since the number of hens in each flock were not the same for each month nor for each type of flock.

[2] Statistically significant at the 1 percent probability level.

Appendix Table 11. Proportion of dirty and cracked eggs by season, by type of flock, 77 commercial egg flocks, Mississippi, 1955-1956.

Type of flock	Number reporting	Time of year				
		Spring	Summer	Fall	Winter	Year
		(Percent dirty)				
Cage	45	6.9	7.0	7.1	7.2	7.08
Floor	32	16.5	17.0	15.4	15.4	16.18
		(Percent cracked)				
Cage	45	3.1	3.1	3.0	3.0	3.03
Floor	32	3.6	3.7	3.5	3.4	3.58

Appendix Table 12. **Proportion of eggs with specified flaws, experimental test flocks, by type of flock, Poultry Department, Mississippi State College, December, 1955-September, 1956.**

Type of flock	Specified flaws				
	Inedible	Dirty	Checks	Leakers	All classifications
			(Percent)		
Cage	2.5	9.9	8.7	2.6	23.7
Floor	.9	15.0	11.0	1.6	28.5

Source: Records obtained from experimental test flocks, Poultry Department, Mississippi State College.

Appendix Table 13. **Proportion of producers cleaning eggs and following selected cleaning methods, by size and type of flock, 77 flocks, Mississippi, 1955-1956.**

Item	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
				(Percent of producers)				
Cleaning practices								
Cleaned all eggs	44	36	38	50	43	25	42	38
Cleaned only dirty eggs	50	64	62	50	57	75	56	62
Did not clean eggs	6	------	------	------	------	------	2	------
Total	100	100	100	100	100	100	100	100
Method of cleaning								
Damp cloth or sponge	61	50	77	50	29	25	56	44
Hand washed	11	29	8	30	14	50	11	34
Dry cleaned[1]	17	21	15	20	28	12	20	19
Mechanical washer	5	------	------	------	29	13	11	3
Did not clean	6	------	------	------	------	------	2	------
Total	100	100	100	100	100	100	100	100

[1] Includes eggs cleaned with a brush, steel wool and sandpaper.

Appendix Table 14. **Proportion of producers who sized and candled eggs by size and type of flock, 77 flocks, Mississippi, 1955-1956.**

Item	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
				(Percent of producers)				
Sized eggs:								
Did	56	64	85	100	86	88	73	81
Did not	44	36	15	------	14	12	27	19
Total	100	100	100	100	100	100	100	100
Candled eggs:								
Did	28	21	62	30	79	38	53	28
Did not	72	79	38	70	21	62	47	72
Total	100	100	100	100	100	100	100	100

Appendix Table 15. Proportions of producers packing eggs within specified times of gathering and storing eggs in specified locations prior to marketing, by size and type of flock, 77 flocks, Mississippi, 1955-1956.

Item	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Time of packing:								
Same day gathered	67	93	69	90	64	100	67	94
Next day or later	33	7	31	10	36	.....	33	6
Total	100	100	100	100	100	100	100	100
Storage location:								
Dwelling house[1]	50	35	46	30	22	12	40	28
Air conditioned room[2]	5	.....	..	20	7		4	6
Basement or cellar		29	15	10	14	13	9	19
Special egg house	28	29	31	30	43	75	34	41
Refrigerator	17	7	8	10	14	....	13	6
Total	100	100	100	100	100	100	100	100

[1] Not air conditioned.

[2] Either dwelling or special storage room.

Appendix Table 16. Proportion of producers selling eggs through various outlets, by size and type of flock, 77 flocks, Mississippi, 1955-1956.

Outlet	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Grocery store	72	57	69	50	93	75	76	59
Institutions	22	21	38	30	43		33	19
Egg dealers	39	21	31	20	14	38	29	25
Retail route	11	29	8	40	14	12	11	28
Home sales	50	29	38	20	21	38	38	38
Miscellaneous[1]	11	14	38	10	43	25	29	16

[1] Cooperatives, bakeries, creameries and food manufacturers.

Appendix Table 17. Proportion of producers selling eggs to specified number of outlets, by size and type of flock, 77 flocks, Mississippi, 1955-1956.

Number of outlets	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
One	39	43	31	50	21	50	31	47
Two	50	43	23	30	43	12	40	31
Three or more	11	14	46	20	36	38	29	22
Total	100	100	100	100	100	100	100	100

Appendix Table 18. Proportion of producers advertising eggs and identifying egg cartons, by type and size of flock, 77 flocks, Mississippi, 1955-1956.

Item	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Advertised eggs:								
Did	------	-- ---	8	- ----	36	- --	13	------
Did not	100	100	92	100	64	100	87	100
Total	100	100	100	100	100	100	100	100
Identified egg cartons:								
Did	23	14	54	20	64	12	44	16
Did not	77	86	46	80	36	88	56	84
Total	100	100	100	100	100	100	100	100

Appendix Table 19. Proportion of producers specifying methods of determining prices and bases of prices received for eggs, by size and type of flock, 77 flocks, Mississippi, 1955-1956.

Item	Size and type of flock							
	Small		Medium		Large		All sizes	
	Cage	Floor	Cage	Floor	Cage	Floor	Cage	Floor
	(Percent of producers)							
Method of determining prices:								
Buyer	45	43	38	40	-- --	38	29	41
Producer	33	36	54	40	57	50	47	40
Buyer and producer	22	21	8	20	43	12	24	19
Total	100	100	100	100	100	100	100	100
Bases of pricing:								
Premium over local market	5	------	15	10	------	-- --	8	3
Allow retailer certain markup	5	7	--	--- -	--	12	2	6
One price year round	28	22	8	10	7	-- --	15	13
Local supply and demand	39	57	23	60	36	38	33	53
Jackson Central Market quotation	17	7	46	10	29	38	29	16
Market quotations in adjoining states[1]	6	-- -	8	10	-- ---	12	4	6
Other central markets[2]	------	7	------	------	28	------	9	3
Total	100	100	100	100	100	100	100	100

[1] Includes markets in New Orleans, Memphis, and Mobile.

[2] Includes markets in New York and Chicago.

BULLETIN 558 MAY, 1958

FOOD USE
and
GAINFUL EMPLOYMENT
OF THE WIFE

By
DOROTHY DICKINS

Mississippi Agricultural Experiment Station
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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SUMMARY

The objectives of the study were to determine differences in kinds, amounts, and sources of food used and time spent in food activities by rural families with the wife gainfully and not gainfully employed.

The two groups of families, 100 with wife gainfully employed and 100 with wife not gainfully employed, all resided in the same rural neighborhoods. All were white families. All consisted of husband and wife with or without children. The wife was 45 years of age or under. Family composition was about the same. The economic family size was 4.20 persons for the gainful homemaker family and 4.16 persons for the non-gainful homemaker family. About two-thirds in each group had school children only or no children; about one-third had pre-school children only, or both pre-school and school children.

Sixty-seven percent of the gainful homemaker families and 79 percent of the non-gainful homemaker families were farm-operator families. Non-gainful wives were somewhat more often married to more successful farmers than gainfully-employed wives. Also, the non-gainful wife had had somewhat more schooling than the gainful wife. Money incomes during the year preceding the survey were about the same in both groups.

Differences in labor-saving food equipment owned by families in the two groups were not statistically significant.

The average per capita money value of home-produced food used during 1955-56 in the gainful wife family was $97; in the non-gainful wife family, $119.

Average money value of food eaten at home in the two groups of families during the week preceding the interview was practically the same—$21.39 and $21.36. However, somewhat more of the food of the gainful wife family was purchased and somewhat more of the food of the non-gainful wife family was home-produced. Meals and snacks eaten away from home during this report week (Spring and early Summer, 1956) averaged $3.66 for the gainful wife family and $1.91 for the non-gainful wife family. Most gainful homemakers took lunch from home.

Similarities in kinds and amounts of foods used by these two groups of families during the report week are more striking than are differences. There was, however, more difference in kinds of foods used that were home-produced and that were purchased. There were fewer families with wife gainfully employed who used home-produced poultry (all kinds), fryers, beef (all kinds), Irish potatoes, pickle, fresh vegetables, fresh fruit, butter, and jelly, preserves, and jam. On the other hand there were significantly more families with the wife gainfully employed who used purchased products including poultry (all kinds), fryers, beef (all kinds), Irish potatoes, catsup, fresh vegetables, cakes, jellies, jams and soft drinks.

The percentage of families using the most ready-prepared foods was somewhat greater in the gainful homemaker family. The big difference was in the use of **new** rather than **old** convenience foods. Ninety-nine percent of the gainful wife families and 95 percent of the non-gainful used, during the report week, one or more old convenience foods, such as baker's bread, peanut butter and frankfurters; while 59 percent of the gainful wife families and 45 percent of the non-gainful used one or more new convenience foods, such as canned biscuit, flour mixes, and non-fat milk.

The baking of biscuit and cornbread was still common in both groups of families. The main difference in baking was in the batches of pie-pastry and cakes baked which was much more common in the non-gainful wife family.

The nutritive value of foods used by families in these two groups during the report week was about the same. Most of both groups had adequate diets. There were only 7 gainful wife and 8 non-gainful wife families having less than two-thirds NRC allowances of one or more food nutrients.

Most homemakers in both groups planned breakfast and the evening meal just before or at the time of preparation. But gainful homemakers planned the evening meal ahead more often than non-gainful ones. The non-gainful wife reported cooking as the homemaking activity she liked best more often than wives gainfully employed.

The greatest difference in time expenditures in food activities in the two groups was in time devoted to food production and preservation; non-gainful women spending more time. The non-gainful homemaker spent about 46 more minutes on a weekday in food preparation and care than did the gainful homemaker. But there was practically no difference in time spent in such activities on a Saturday and Sunday.

Differences found in time expenditure between gainful and non-gainful wife families at the last main weekday meal were related to the fact that menus served in gainful wife families took less time to prepare (that is, contained fewer preparation units). The gainful wife family was no more efficient than the non-gainful wife family considering type of menus and number of persons served.

IMPLICATIONS

For Producers and Distributors

With an increasing number of rural women entering gainful work there will be changes in kinds of foods purchased. Many of the gainful wife families will reduce home-production of specified foods and purchase in the market. This shift it would seem might be especially marked in case of beef (all kinds), poultry (all kinds) and vegetables.

More foods requiring limited preparation time will be demanded. The gainfully-employed homemaker is no less efficient in her food preparation than her stay-at-home sister, yet she has less time to spend in this activity. Furthermore, she does not enjoy cooking as much as does her stay-at home sister.

It behooves producers and distributors to adjust programs to fit the wants of this growing group of rural families.

For Educators

With more rural women entering gainful work, producers and distributors will need assistance in making needed adjustments if they are to provide the foods this changing family wants. More research is needed on which to base such educational programs. We need to know more about changes in food as the homemaker shifts from non-gainful to gainful work and more about inter-relationships of gainful work for the homemaker and place of residence, rural or urban.

Food Use and Gainful Employment of the Wife

By DOROTHY DICKINS

INTRODUCTION

What are the differences in food use of rural families in which wives have and do not have gainful work? This is the question with which this report is concerned. The growing tendency of homemakers to work away from home, with now about one out of four thus employed, increases the dependence of families on the market. Is choice and use of food affected? A reply to this question is important not only to producers and distributors but also to the family.

Information on kinds, amounts, and sources of foods used, time spent in food activities, and related data in homes with the wife gainfully and not gainfully employed provides basic information to producers and to distributors for adjusting production and marketing to the demands and needs of families in which there are increasing numbers with homemakers gainfully employed. Such adjustments will result in greater availability of foods which these kinds of families want.

SCOPE AND METHODS

The sample of families with the wife gainfully employed (including 100 families) was drawn from lists of white married women employed in garment plants in Maben, Union, and Caledonia, Mississippi. The sample of families with the wife not gainfully employed (including 100 families) was taken from the same rural areas. The non-gainful homemaker families were similar as far as was possible to the gainful homemaker families: (1) All were white families; (2) All had both husband and wife; (3) The family composition was approximately the same; and (4) The ages of the homemakers were approximately the same. Homemakers in the non-gainful group had not had gainful work in the past two years.

Data were obtained during the Spring and early Summer of 1956 by personal interview with the use of a schedule.

DESCRIPTION OF FAMILIES

Income of the two groups of families during 1955-56 (the year preceding the interview) were about the same. Incomes were distributed as follows:

Income	Gainful homemaker families Percent	Non-gainful homemaker families Percent
$1999 and under	22	25
$2000 - $3999	61	59
$4000 - $5999	13	14
$6000 and over	4	2

The average number of members supported by this income was 4.20 persons for the gainful homemaker family and 4.16 persons for the non-gainful homemaker family.[1] Sixty seven percent (or 67) of the gainful homemaker families and 79 percent (or 79) of the non-gainful homemaker families were farm-operator families. Fifty families with wife gainfully employed and 73 with the wife having no gainful work owned the farms they operated. In 52 families with a gainful wife and in 59 with a non-gainful wife, the husband's main occupation was farming.

Farming was the main source of the family income for only 15 of the families with the wife gainfully employed but for 59 of the families with wife not having such work. In 46 of the families with wife gainfully employed the wife's industrial work was the main source of family income. The husbands in 37 of these 46 families were farm operators; in 9 they had non-farm work. From the data available it would therefore seem that the non-gainful women were somewhat more often married to farmers and to more successful farmers.

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[1] The average size of the household during report week was 4.05 persons for gainful wife families and 4.23 persons for non-gainful wife families. Household size was computed by dividing the total number of meals served during the week by 21 (meals per week).

Also, the non-gainful wife had had more schooling than the gainful wife, as is shown:

Grades completed	Gainful wives Percent	Non-Gainful wives Percent
9 or less	36	30
10 - 11	32	14
12	30	38
Attended college and/or had special training beyond high school	2	18

Seventy-five percent of the gainful homemaker families and 73 percent of the non-gainful homemaker families owned an auto; 40 percent of the former and 55 percent of the latter owned a truck. There were only 6 of the 200 families having neither auto nor truck—4 with wife gainfully employed and 2 with wife having no gainful employment.

Thirty-five of the non gainful homemakers had had gainful work experience. The average number of years of such experience by the 35 having it was 5. Twenty had done factory work but gainful work experience of only 9 of these was limited to factory work only.

Seventy-two of the gainfully-employed wives had had factory work experience only. These gainful wives averaged also 5 years gainful experience. Only 17 had worked less than one year.

CHILDREN OF GAINFUL AND NON-GAINFUL HOMEMAKERS

Since an attempt was made to keep the family composition of the two groups the same, one would not expect much difference in the number and ages of the children. The summary below shows the percentage of families in the two groups with no children, school children only, pre school children only, and with both school and pre-school children:

	Gainful homemaker families Percent	Non-gainful homemaker families Percent
No children	19	15
School children only	46	47
Pre-school children only	15	18
Both school and pre-school	20	20

Gainfully employed homemakers were asked: "Who is in charge of the children when you are at work?" Eleven with pre-school children reported a maid; 11, mother or other relative; 7, husband; and 5, neighbor. One woman took her pre-school child to a nursery school. Thirty-four with school children reported husband; 16, no one; 9, mother or other relative; 4, maid; and 3, neighbor in charge of children when she was away at work.

FOOD PREPARATION FACILITIES

Non-gainful homemaker families owned on the whole somewhat more labor-saving food preparation equipment than did gainful homemaker families, but the differences were not statistically significant. (See Table 1 in Appendix). The two exceptions to this statement were a mechanical refrigerator and a gas or electric cook stove. Ninety-nine families in each group had a mechanical refrigerator. Ninety-two percent of the gainful homemaker families and 81 percent of the non-gainful homemaker families had a gas or electric cook stove.

HOME-PRODUCED FOOD

In Table 2 of the Appendix the percentage of gainful and non-gainful homemaker families using home-produced food of specified kinds and the average money value of these foods per family during 1955-56 is shown. Home-produced foods used by the family were valued at the price the farmer could have received for them if he had sold them. Prices compiled by the Marketing Service of the United States Department of Agriculture for Mississippi were used as far as was possible. However, these compilations did not include some of the foods produced and co

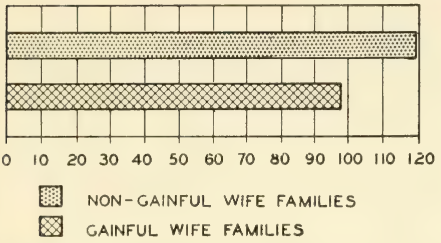

Figure 1. Average per capita money value home-produced foods used 1955-56 by gainful and non-gainful wife families.

sumed by the 200 families. For these, prices received by local farmers in the study area during 1955-56 were collected and the most typical used.

Differences in percentages of gainful and non-gainful homemaker families using home-produced foods of specified kinds during 1955-56 were statistically significant for three kinds of foods—frozen poultry, frozen vegetables, and jams, jellies and preserves. In these cases a higher percentage was used by non-gainful homemaker families.

The greatest difference in average money value of foods used per family was in frozen meats and eggs. Here, too, money values were greater for the non-gainful homemaker family. Average per capita money value of home produced food used during 1955-56 in the gainful wife family was $97; in the non-gainful wife family, $119 (Figure 1).

FOOD CONSUMPTION DURING REPORT WEEK

A large part of the family interview schedule was devoted to getting a record of kinds, amounts, sources, and costs of foods used during the week preceding the interview. The same field agents interviewed both groups of families within an area. Interviews were made in the Spring and early Summer of 1956.

Shown below is the average expense of purchased food and money value of home-produced food used by these two groups of families during the report week:

Item	Gainful homemaker families Dollars	Non-gainful homemaker families Dollars
Expenses for Food		
Food at home or in packed lunches	14.30	12.09
Meals away from home	2.14	.97
Snacks and supplements away from home	1.52	.94
Total expense	17.06	14.00
Food Without Direct Expense		
Value home-produced food	6.69	8.95
Value gifts	.40	.32
Total value	7.09	9.27
Money Value all Food Eaten at Home	21.39	21.36
Money Value all Food	25.05	23.27

Average money value of food eaten at home by the two groups of families was practically the same ($21.39 and $21.36). But somewhat more of the food of the gainful wife family was purchased and somewhat more of the food of the non-gainful wife family was home-produced.

Most of the gainfully-employed women took lunch from home. Many of these women prepared lunch for their families as well as for themselves before leaving for work. Included in the group of gainfully-employed were some women who worked in late afternoon and the first part of the night. These prepared their noon or main meal.

Kinds, amounts, and sources of foods used. Similarities in the kinds and amounts of foods used by these two groups of families are more striking than the differences. (See Table 3, in Appendix).

There were only four foods used during the report week (See Table 3 in Appendix) where differences between the two groups were statistically significant. These were fish (fresh or frozen), sweet potatoes, cakes, and soft drinks. More families of the non-gainful homemaker used fish (usually caught from nearby streams) and more families of the gainful homemaker used the other three foods. The average quantities of the various kinds of food used were not greatly different.

Food producers and distributors are, however, interested in differences in kinds and amounts of home-produced and purchased foods used rather than in the totals used. Such figures point out potential markets. In this study made during the Spring, including June, there were significantly **fewer families** with the wife gainfully employed who used **home-produced:** poultry (all kinds), fryers, beef (all kinds), Irish potatoes, pickles, fresh vegetables, fresh fruit, butter, jelly, preserves, and jam. (See Table 4 in the Appendix). On the other hand, there were significantly **more families** with wife gainfully employed who used **purchased** products including poultry (all kinds), fryers, beef (all kinds), Irish potatoes, catsup, fresh vegetables, ready-prepared cakes, soft drinks, and jellies and jams (See Table 5 in Appendix).

It would seem that many gainful homemaker families continue to produce pork and eggs, and that they give up making jelly and preserves before they give up making pickles.

The family cow was not disposed of as often as one might think. One factor may be that many of these women had young children and dairies did not ordinarily deliver in these rural areas. Forty-one percent of the gainful homemaker families reported using pasteurized milk altogether; 11 percent, sometimes. The percentages for the non-gainful homemaker families were 35 percent and 6 percent respectively. Several families in each group had their own home pasteurizers.

Another point of interest is the shift from home-prepared to ready-prepared foods. The percentage of families using most ready-prepared foods was somewhat greater for the gainful homemaker family. Note the percentage using lunch meat, canned fish, ready-prepared mixtures with meat, ice cream, canned vegetables, canned fruits, bakery products of all kinds, salad dressing, and ready-prepared soup in Table 3 in the Appendix.

The big difference between the two groups was in **new** rather than **old convenience foods.** Ninety-nine percent of the gainful wife families and 95 percent of the non-gainful wife families used one or more old convenience foods such as baker's bread, ice cream, peanut butter, ground beef, frankfurters, preserves, jellies, jams and ready-prepared soup during the report week. Fifty-nine percent of the gainful wife families and 45 percent of the non-gainful wife families used one or more of the new convenience foods during the report week. (Figure 2). (This difference is statistically significant). Such foods include canned biscuit, frozen fruits, instant coffee, flour mixes, brown and serve rolls, non-fat dry milk, canned baby food.

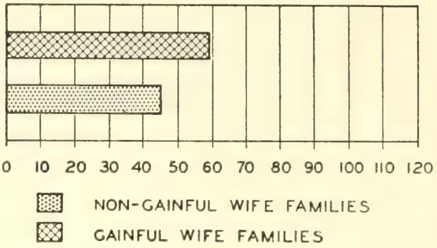

Figure 2. Percentage of gainful and non-gainful wife families using one or more new convenience foods during report week.

During the report week all families made one or more batches of bread, cake, and/or pastries (See Table 6 in the Appendix). In homes of gainful homemakers an average of 15.8 batches of bread, cakes, and pies were baked during the week. In homes of the non-gainful homemaker the average was 17.8 batches (See Table 7 in Appendix). Both groups averaged eight batches of biscuit and six batches of cornbread during this period. The main difference between gainful and non-gainful wife families was in batches of pie-pastry and cakes baked. Such preparation was much more frequent in families in which the wife did not have gainful work.

Nutritive Value of Food Used. How well did the diets of the two groups of families whose food records form the basis of this study meet standards of good nutrition? This question can be answered, in part, from calculations made to find the approximate food energy values and quantities of protein, calcium, iron, vitamin A value, thiamine, riboflavin, niacin, and ascorbic acid available to each family. The results were compared with the Recommended Dietary Allowances of the National Research Council, hereafter called NRC allowances. The allowances for the physically active man 21-34 years old, 69 inches in height and 160 pounds in weight, were considered equal to one nutrition unit, and the allowances for persons of differing sex, age, and physical activity were expressed as relatives of the man's allowance. Values per nutrition unit mean that for each 3000 calories, 75 grams of protein, .8 gram of calcium, etc., recommended, the indicated amounts were supplied by the diets. The average supply of nutrients in the diets of both groups furnished more of each of these nutrients than NRC allowances. (See Table 8 in the Appendix).[2]

Average values, however, may conceal variations in the supply of nutrients individual families had during the report week. A tabulation was therefore prepared showing percentage of families short in energy, protein, and the seven nutrients (See Table 9 in Appendix). Thirty-four percent of the gainful homemaker families and 28 percent of the non-gainful homemaker families were short in one or more nutrients. Shortages were almost altogether limited to ascorbic acid and vitamin A value.

Diets which furnish two-thirds or more of the NRC allowance for a given nutrient may with some validity be regarded as beyond the point where the supply of that nutrient presents a serious problem. Ninety-three percent of the gainful homemaker families and 92 percent of the non-gainful homemaker families had diets that furnished two thirds or more of the NRC recommended allowance for energy, protein, and each of the seven nutrients.

The nutritive value of the foods used by the families in these two groups was about the same. Both groups had adequate diets. There was less than one in ten with a serious deficiency in one or more food nutrients.

FOOD MANAGEMENT

It was thought that the attitudes towards food preparation of gainful and non-gainful homemakers might be different and that this fact might affect their food management. Therefore, each interviewee was questioned about homemaking tasks she liked best and least. Sixty-two percent of the non-gainful wives named food preparation as the homemaking activity they liked best, but only 44 percent of the gainful wives (a statistically significant difference) ranked food preparation as their favorite homemaking activity. About the same number of wives in each group named food preparation as the homemaking task they liked least of all. The percentage was eight for non-gainful wives and nine for gainful wives.

All homemakers interviewed were asked, "When did you plan breakfast, the noon meal, and the evening meal yesterday?" Breakfast was planned by 85 percent of the women in each group just before or at the time of preparation; the evening meal also was generally planned this way. (See Table 10 in the Appendix). But the gainful homemaker somewhat more often planned the noon meal ahead (the night before, or previous to the night before) than did the non-gainful homemaker. The difference between the two groups of homemakers planning the noon meal ahead was not statistically significant. However, this difference approached significance. A significant difference might have been shown with a larger number of family schedules.

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[2] Quantities of food consumed by households or available for consumption, were multiplied by figures for the nutritive value of foods in terms of energy, protein, and seven other nutrients. A duplicate set of nutritive value cards used in the Household Food Consumption Survey of 1955 of the Agricultural Research and Marketing Service of the U. S. Department of Agriculture was purchased from National Analysts, Inc., by whom data were collected and tabulated for these government agencies. These cards gave nutritive values per pound after cooking losses.

TIME EXPENDITURES OF WIVES AND OTHERS

Homemakers were asked to report time expenditures in (1) food preparation and care, (2) all dish-washing and cleaning up after meals, (3) all food production and preservation, and (4) food shopping—on the last week day, Saturday, and Sunday preceding the interview—by themselves and by others who assisted.[3] Non-gainful wives spent on these four kinds of food activities 158 more minutes on the weekday, 55 more minutes on Saturday, and 9 more minutes on Sunday than did gainful wives. In the homes of these two groups of families, however, 124 more minutes were spent on the weekday, 79 more minutes on Saturday and 16 on Sunday by non-gainful wife families.

The biggest difference in time expenditures in the two groups was in time devoted to food production and preservation. Non-gainful women spent more time than gainful women (See Table 11 in Appendix). The non-gainful wife spent a little over 1½ hours on the weekday, a little less than an hour on Saturday and about 1/5 of an hour on Sunday more time on this type of activity than did the gainful wife.

Non-gainful homemakers spent about 46 more minutes on the weekday meal in food preparation and care than did gainful homemakers. There were practically no differences in the time spent in such activities by the two groups of homemakers on Saturday and Sunday (See Table 11 in the Appendix for time expenditures in 4 types of food activities).

EXPENDITURES PER PREPARATION UNIT

Homemakers were asked, "What was the main meal served at home on the last weekday preceding this interview?" They were then asked to name all dishes and foods served and to classify the dishes; that is, whether they were (1) prepared on this weekday, and if so, (a) whether prepared from raw materials or (b) from processed materials including mixes; (2) previously prepared (i.e. left-overs, from home freezer, etc.); or (3) bought ready-prepared. They were asked about the number of persons served at this meal and the total preparation time involved. For example, if the homemaker spent 30 minutes and her daughter 15 minutes, the time recorded was 45 minutes.

Preparation units of each menu served were estimated. The procedure for estimating the total preparation units of the menu was as follows: Food requiring no preparation such as left-over pie, baker's bread, ready-prepared pickles, butter, and milk were scored as one preparation unit. Limited preparation such as canned vegetables, coffee and fried bacon were scored as two preparation units. Dishes prepared from raw foods such as roast beef, fried chicken, fresh boiled beans, or a cake made with a mix, were scored as three preparation units. Where there was much preparation, as for a cake or pie made without the use of a mix, the score given was four preparation units.

In Table 12 in the Appendix the relation of time spent in preparation by all members at this last weekday main meal and the number of preparation units in the menus served is shown. For both groups of families expenditures in time is less when preparation units are less and expenditures in time greater when preparation units are greater. The gainful wife family more often reported a menu with fewer preparation units than the non-gainful wife family. Fifty eight percent of the menus of gainful wife families and 40 percent of the menus of non-gainful wife families had less than 16 preparation units (Figure 3).

The question might be asked here as to the efficiency of the two groups of families in preparation. By this is meant the difference in average time per unit per person served that was spent on this main weekday meal. Such a calculation gave 1.07 minutes per

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[3] Time expenditures are limited to actual time given to the activity. For example, one might have cake in an oven, and at the same time do the ironing. This would be regarded as a time expenditure in laundry work, not a time expenditure in food preparation.

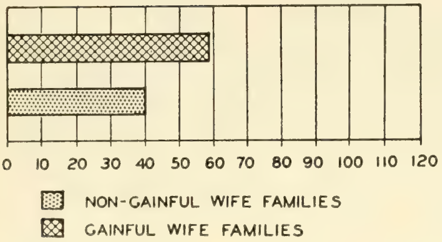

Figure 3. Percentage of gainful and non-gainful wife families reporting menus on main meal served last weekday with less than 16 preparation units.

unit of preparation per person for both groups.

One might conclude that there is little if any difference in food management in these two groups of women. Both planned breakfast and the evening meal just before or at the time of preparation. There was a tendency for the gainful wife group to do more preplanning in connection with the noon meal, but the difference was not statistically significant. In both groups of families an average of 1.07 minutes per person per preparation unit was spent on the last weekday main meal before the interview.

That the non-gainful homemaker and her family spent more time in food preparation and care on a weekday is related to the type of menu served. Her menu had a greater number of preparation units. Perhaps it is related also to the fact that homemakers not gainfully employed liked to cook more than those gainfully employed.

APPENDIX TABLES

Table 1. Percentage of gainful and non-gainful wife families owning specified food equipment.*

Equipment	Gainful wife families	Non-gainful wife families
	Percent	Percent
Kitchen sink	64	77
Electric mixer	27	40
Water in kitchen	59	67
Pressure sauce pan	70	78
Mechanical refrigerator	99	99
Home freezer	43	48
Rent community locker	9	17
Electric cook stove	38	41
Gas cook stove	54	40

*One family in each group owned an electric dish washing machine.

Table 2. Percentage of gainful and non-gainful wife families using home-produced foods* of specified kinds and average money value of these foods during the year preceding the interview, 1955-56.

Item	Families-using, wife		Average money value of foods, wife	
	Gainful work	No gainful work	Gainful work	No gainful work
	Percent	Percent	Percent	Percent
Canned meats	5	9	.91	1.88
Frozen meats	52	60	59.64	78.62
All other meats, fresh, cured	64	71	35.81	35.31
All poultry, canned	0	1	0	.23
All poultry, frozen	30	44	6.70	9.25
All other poultry, fresh	54	66	11.75	17.93
Eggs	69	77	31.12	47.76
Potatoes	59	70	10.72	14.66
Milk	65	71	96.05	102.49
Vegetables, fresh	96	99	49.62	60.98
Vegetables, canned	88	93	40.41	41.66
Vegetables, frozen	42	60	13.47	18.80
Dry peas and beans	41	45	1.52	1.57
Fruit, canned	21	25	1.06	1.85
Fruit, frozen	6	9	.45	.75
Jellies, jams, preserves	27	61	1.56	3.93
Pickles, relishes	87	87	5.31	5.46
Syrup	11	18	1.33	1.87
Cornmeal	25	33	6.01	9.99

*Includes foods secured from woods, fields, etc., as well as home-produced.

Table 3. Percentage of gainful and non-gainful wife families using, average amount used and average money value[1] of specified foods during one week, Spring and early Summer, 1956.

Food	Families using, Wife		Quantity per household, all households, wife		Money value per household, all households, wife	
	Gainful work	No gainful work	Gainful work	No gainful work	Gainful work	No gainful work
MEATS, POULTRY, FISH, EGGS:	Percent	Percent	Lbs.	Lbs.	Dollars	Dollars
All poultry	67	78	2.37	2.69	.90	.83
Friers only	64	74	2.06	2.51	.79	.78
Pork (all kinds)	99	95	5.49	5.25	2.03	1.69
Beef (all kinds)	72	72	2.14	2.91	.89	1.04
Veal	1	2	.03	.04	.02	.02
Variety Meats (liver, tongue, etc.)	7	10	.09	.12	.03	.04
Lunch meat	51	42	.80	.58	.38	.26
Game	0	2	—	.06	0	.01
Fish (fresh or frozen)	18	33	.56	1.14	.15	.29
Canned Fish	35	32	.36	.23	.24	.16
Shellfish	0	3	—	.04	0	.02
Ready prep. mixtures with meat	13	9	.27	.09	.08	.02
Hamburgers	2	0	.02	—	.01	—
Eggs	98	99	3.34	3.93	.98	.98
MILK, CREAM, ICE CREAM, CHEESE:						
Fluid milk (all kinds)	100	100	46.59	48.07	2.96	2.10
Evaporated milk	22	12	.59	.29	.10	.03
Condensed milk	6	9	.08	.10	.03	.02
Dry milk	13	5	.12	.07	.05	.02
Cream (fluid)	4	8	.10	.18	.02	.05
Cottage cheese	1	3	.01	.05	*	.02
American cheese	47	48	.62	.62	.34	.31
All other cheese	6	2	.04	.01	.03	.01
Ice cream	47	43	1.22	1.23	.38	.32
Sherbet	1	0	*	—	*	0
VEGETABLES:						
Dried peas and beans	34	26	.65	.26	.10	.04
Irish potatoes	86	89	5.14	4.64	.35	.24
Potato chips, sticks	0	3	—	.01	0	.01
Sweet potatoes	27	14	1.39	.42	.06	.03
Sweet potatoes (canned)	3	0	.07	—	.01	0
Pickles	60	67	1.28	1.13	.12	.09
Fresh tomatoes	50	38	1.80	.95	.31	.14
Canned tomatoes	31	34	1.15	1.28	.10	.10
Tomato juice and puree	15	16	.60	.50	.04	.04
Catsup, chili sauce, tomato sauce	42	30	.37	.27	.07	.06
All fresh vegetables (except tomatoes and potatoes)	96	99	7.11	10.69	.70	.95
All canned vegetables (except tomatoes and potatoes	76	71	5.46	4.22	.83	.62
All frozen vegetables	47	56	2.44	3.96	.43	.66
FRUITS:						
Fresh citrus fruits	58	62	2.75	2.85	.24	.27
Frozen orange conc.	5	12	.06	.14	.02	.06
Canned citrus juice	12	13	.37	.34	.05	.03
All fresh fruits (except citrus)	75	81	3.80	4.82	.47	.51
Frozen fruit	5	9	.07	.19	.01	.03
Other juices (not citrus frozen)	3	2	.12	.06	.02	*
Other juices (not citrus canned)	2	2	.06	.10	.01	.01
All canned fruit (not juice or citrus)	53	49	1.47	1.01	.26	.16
Dried fruit	14	16	.18	.18	.06	.06
GRAIN PRODUCTS:						
Flour (all kinds)	100	100	7.93	8.69	.74	.83
Flour mixes (all kinds)	22	12	.30	.22	.09	.06
Cornmeal	93	100	5.85	5.82	.44	.48
Rice	34	43	.28	.39	.06	.11
Other cereal (as hominy grits, etc.)	17	20	.36	.25	.04	.04
Breakfast cereal (not ready-prepared)	35	41	.41	.41	.06	.08
Ready-prepared breakfast cereals	43	43	.52	.37	.17	.13
Macaroni & Spaghetti	14	17	.13	.10	.04	.03
Bakery bread (including ready-to-eat rolls)	91	88	3.20	3.13	.51	.46
Brown and serve rolls, canned biscuit	25	23	.28	.21	.08	.06

[1] Expenses plus money value of home-produced and gift foods used.

*Less than $.01.

Table 3. (Continued)

Food	Families using, Wife		Quantity per household, all households, wife		Money value per household, all households, wife	
	Gainful work	No gainful work	Gainful work	No gainful work	Gainful work	No gainful work
	Percent	Percent	Lbs.	Lbs.	Dollars	Dollars
Crackers (all kinds)	65	53	.68	.57	.18	.15
Cakes (ready-prepared)	24	8	.32	.12	.15	.04
Pie (ready-prepared)	2	0	.02	0	.01	0
All other baked goods as cookies, doughnuts	31	21	.44	.29	.16	.09
FATS, OILS:						
Butter and oleo	98	99	1.64	2.04	.65	.76
Cooking oil	10	12	.08	.16	.04	.07
Cooking fats	98	98	2.92	2.66	.54	.70
Salad dressing (french dressing mayonnaise)	92	89	.86	.80	.36	.43
SUGARS AND OTHER SWEETS:						
Sugar (all kinds)	96	100	5.09	5.38	.48	.54
Syrups (all kinds)	67	58	2.10	1.53	.26	.23
Honey	1	10	*	.09	*	.04
Jelly, jam, preserves	62	72	.81	1.43	.21	.25
Candy	23	26	.13	.21	.09	.07
Misc. sweets as sweetened gelatin and pudding mix	8	11	.04	.04	.02	.02
READY-PREPARED SOUP	19	12	.35	.22	.07	.02
NUTS:						
Shelled, including peanut butter	46	44	.39	.33	.18	.18
Unshelled	2	5	.05	.06	*	.02
BABY FOODS	7	6	.25	.27	.08	.09
ACCESSORIES:						
Soft drinks	61	47	2.74	2.68	.37	.25
Chocolate and cocoa	23	24	.06	.11	.07	.10
Yeast	2	11	*	.01	*	.01
Ground coffee	80	75	.76	.58	.74	.80
Powdered coffee	12	15	.02	.02	.15	.17
Coffee substitute	0	3	—	.01	0	.02

*Less than $.01.

Table 4. Percentage of gainfully employed and non-gainfully employed wife families using home-produced food of specified kinds during report week, 1956.*

Food	Families with wife	
	Gainful work	No gainful work
	Percent	Percent
All poultry	25	49
Fryers only	23	48
Pork, all kinds	59	58
Beef, all kinds	31	46
Veal	0	2
Variety meats	3	5
Game	0	2
Fish (fresh & frozen)	14	25
Ready-prepared mixtures with meat	1	1
Eggs	63	69
Fluid milk	58	71
Cream	4	5
Cottage cheese	0	1
Dried peas & beans	13	6
Sweet potatoes	16	7
Irish potatoes	5	29
Pickles	50	64
Canned tomatoes	26	28
Tomato juice & puree	11	15
All fresh vegetables except tomatoes & potatoes	58	75
All canned vegetables except tomatoes & potatoes	55	56
All frozen vegetables	40	52
All fresh fruit except citrus	4	37
Frozen fruit	4	4
All canned fruit, not juices or citrus	16	19
Dried fruit	0	3
Cornmeal	20	26
Other cereal, as hominy and grits	5	2
Butter	29	48
Cooking fats	42	53
Syrups	9	6
Honey	0	2
Jelly & preserves	16	48
Ready-prepared soup	7	8
Nuts, no shell, includes peanut butter	4	3
Nuts in shell	0	3
Catsup, chili sauce, tomato sauce	8	9

*A few families used food from more than one source.

Table 5. Percentage of gainfully employed and non-gainfully employed wife families using bought food items and average expenditures by all families for each of these items during one week, Spring and early Summer, 1956.**

FOOD	Using bought, wife		Average expense per household, all households, wife	
	Gainful work	No gainful work	Gainful work	No gainful work
MEATS, POULTRY, FISH, EGGS:	Percent	Percent	Dollars	Dollars
All poultry	44	29	.61	.37
Fryers only	43	28	.58	.36
Pork (all kinds)	60	50	.92	.58
Beef (all kinds)	43	29	.54	.36
Veal	1	0	.02	0
Variety meats (liver, tongue, etc.)	4	5	.02	.02
Lunch meat	51	42	.38	.26
Fish (fresh or frozen)	4	9	.04	.05
Canned fish	35	32	.24	.16
Shellfish	0	3	0	.02
Ready-prepared mixtures with meat	13	8	.08	.02
Eggs	36	31	.37	.20
MILK, CREAM, ICE CREAM, CHEESE:				
Fluid milk	47	37	1.17	.94
Evaporated milk	22	12	.10	.03
Condensed milk	6	9	.03	.02
Dry milk	13	5	.05	.02
Cream (fluid)	0	3	0	.02
Cottage cheese	1	2	*	.01
American cheese	47	48	.34	.31
All other cheese	6	2	.03	.01
Ice cream	47	43	.38	.32
Sherbet	1	0	*	0
VEGETABLES:				
Dried peas and beans	23	19	.07	.04
Irish potatoes	81	60	.34	.16
Potato chips, sticks	0	3	0	.01
Sweet potatoes	11	7	.02	.02
Sweet potatoes, canned	3	0	.01	0
Pickles	11	5	.03	.02
Fresh tomatoes	50	38	.31	.14
Canned tomatoes	5	6	.03	.01
Tomato juice and puree	4	1	.01	.01
Catsup, chili sauce, tomato soup	36	22	.06	.05
All fresh vegetables (except tomato and potato)	85	64	.39	.25
All canned vegetables (except tomato and potato)	36	26	.18	.07
All frozen vegetables	7	4	.04	.02
FRUITS:				
Fresh citrus fruit	58	62	.24	.27
Frozen orange concentrated	5	12	.02	.06
Canned citrus juice	12	13	.05	.03
All fresh fruit (except citrus)	72	66	.45	.34
Frozen fruit	1	5	*	.02
Other juices (not citrus) frozen	3	1	.02	*
Other juices (not citrus) canned	2	1	.01	.01
All canned fruit (not juices or citrus)	38	32	.23	.18
Dried fruit	14	13	.06	.05
GRAIN PRODUCTS:				
Flour (all kinds)	100	100	.74	.83
Flour mixes (all kinds)	22	12	.09	.06
Cornmeal	78	74	.52	.37
Rice	34	43	.06	.11
Other cereal (as hominy, grits)	12	18	.03	.04
Breakfast cereal (not ready-prepared)	35	41	.06	.08
Ready-prepared breakfast cereal	43	43	.17	.13
Macaroni and spaghetti	14	17	.04	.03
Bakery bread (include ready-to-eat rolls)	91	88	.51	.46
Brown and serve rolls and canned biscuit	25	23	.08	.06
Crackers (all kinds)	65	53	.18	.15
Cakes (ready-prepared)	24	8	.15	.04
Pie (ready-prepared)	2	0	.01	0
All other baked goods as cookies, doughnuts	31	21	.16	.09
FATS AND OILS:				
Butter or oleo	74	66	.35	.21
Cooking oil	10	12	.04	.07
Cooking fats	60	53	.37	.51
Salad dressing (french dressing, mayonnaise)	92	89	.36	.43

*Less than $.01.

**A few families used food from more than one source.

Table 5. (Continued)

FOOD	Using bought, wife		Average expense per household, all households, wife	
	Gainful work	No gainful work	Gainful work	No gainful work
SUGARS AND OTHER SWEETS:	Percent	Percent	Dollars	Dollars
Sugar (all kinds)	96	100	.48	.54
Syrups (all kinds)	59	52	.23	.27
Honey	1	8	*	.04
Jelly and preserves	47	26	.19	.10
Candy	23	26	.09	.07
Miscellaneous sweets as sweetened gelatin and pudding mix	8	11	.02	.02
SOUP:				
Ready-prepared soup	13	4	.06	.01
NUTS:				
Shelled, including peanut butter	42	41	.18	.17
Unshelled	2	2	.01	.01
BABY FOODS:	7	6	.08	.09
ACCESSORIES:				
Soft drinks	61	47	.37	.25
Chocolate and cocoa	23	24	.07	.10
Yeast	2	11	*	.01
Ground coffee	80	75	.74	.80
Powdered coffee	12	15	.15	.17
Coffee substitute	0	3	0	.02

*Less than $.01.

Table 6. Percentage of gainful and non-gainful wife families making specified breads, pastry, etc., during report week, 1956.

Batches bread, etc.	Families with wife		Batches bread, etc.	Families with wife	
	Gainful work	No gainful work		Gainful work	No gainful work
	Percent	Percent		Percent	Percent
Yeast bread	1	6	Yellow cake with fat	20	29
Yeast rolls	2	12	Chocolate cake with fat	4	25
Biscuit	100	96	Other cake with fat	1	5
Griddle cakes, waffles	5	9	Cake with no fat	3	4
Cornbread	91	94	Cookies	9	15
Other, muffins	2	7	Pie pastry	40	67
Gingerbread	0	3	% families with 1 or more batches	100	100
White cake with fat	19	29	% families using 1 or more mixes	22	12

Table 7. Average number batches bread, cakes made by gainful and non-gainful wife families during report week, 1956.

Item	Families with wife		Item	Families with wife	
	Gainful work	No gainful work		Gainful work	No gainful work
	Av. No. batches	Av. No. batches		Av. No. batches	Av. No. batches
Yeast bread	.01	.11	Gingerbread	0	.03
Yeast rolls	.03	.16	Cake with fat (all kinds)	.60	1.14
Biscuit	7.89	7.77	Cake, no fat	.02	.05
Griddle cakes, waffles	.11	.17	Cookies	.12	.22
Cornbread	6.29	6.48	Pie pastry	.72	1.51
Other muffins	.07	.14	TOTAL AVERAGE	15.76	17.78

Table 8. Average nutritive value of diets per nutrition unit per day from food used at home in a week, Spring and early Summer, 1956, by 100 families with wife gainfully employed and 100 with wife not having gainful employment, compared with the standard recommended by the National Research Council.

Nutrients	Unit	Standard	Gainful wife families	Non-gainful wife families
Energy	calories	3,000	5,340	5,460
Protein	grams	75	125	124
Calcium	grams	.8	1.59	1.55
Iron	milligrams	12	23.2	22.6
Vitamin A	International Units	5,000	9,350	9,050
Thiamine	milligrams	1.5	2.73	2.62
Riboflavin	"	1.9	3.27	3.21
Niacin	"	15	26.4	26.7
Ascorbic Acid	"	75	98	107

Table 9. Percentage of gainful and non-gainful wife families who had less than NRC recommendations during one week, Spring and early Summer, 1956.

Item	Gainful wife family	Non-gainful wife family
	Percent	Percent
One or more nutrients	34	28
Energy	0	0
Protein	2	3
Calcium	0	0
Iron	0	0
Vitamin A	14	15
Thiamine	1	0
Riboflavin	3	2
Niacin	0	2
Ascorbic Acid	27	23

Table 10. When wives gainfully and not gainfully employed planned meals the day before the interview.

When Planned	BREAKFAST		NOON MEAL		EVENING MEAL	
	WIFE		WIFE		WIFE	
	Gainful work	No gainful work	Gainful work	No gainful work	Gainful work	No gainful work
	Percent	Percent	Percent	Percent	Percent	Percent
Just before or at time of preparation	85	85	11	51	63	79
Night before	10	14	45	43	6	15
Previous to night before	2	1	17	6	13	6
Someone else did the planning	2	0	21	0	14	0
Meal not served	1	0	6	0	4	0

Table 11. Average time expenditure in specified types of food activities the last weekday, Saturday and Sunday preceding the interview in homes of gainful and non-gainful wife families and by gainfully employed and non-gainfully employed wives.

Food Activity and Day	Total Time		Time by Wives Themselves	
	In Homes Gainfully employed wives	**In Homes** Non-gainfully employed wives	Gainfully employed	Non-gainfully employed
All food preparation and food care:	hrs.	hrs.	hrs.	hrs.
Last Weekday	2.15	2.55	1.55	2.32
Last Saturday	2.40	2.50	2.22	2.33
Last Sunday	2.37	2.33	2.17	2.17
All dish washing and cleaning up:				
Last Weekday	.97	1.15	.53	.87
Last Saturday	1.15	1.12	.97	.82
Last Sunday	1.05	1.15	.88	.85
All food production and preservation:				
Last Weekday	1.10	2.68	.28	1.97
Last Saturday	.65	1.80	.27	1.15
Last Sunday	.50	.73	.17	.37
Shopping for food:				
Last Weekday	.47	.38	.47	.30
Last Saturday	.17	.27	.15	.22
Last Sunday	.02	0	.02	0
Total:				
Last Weekday	4.69	6.76	2.83	5.46
Last Saturday	4.37	5.69	3.61	4.52
Last Sunday	3.94	4.21	3.24	3.39

Table 12. Relation of time spent in preparation by all members at last weekday main meal and number of preparation units in menu served in families with wife having and not having gainful work.

Time spent in preparation	Gainful wife families				Non-gainful wife families			
	Number preparation units				Number preparation units			
	Under 13	13-15	16-20	21 & over	Under 13	13-15	16-20	21 & over
Minutes:								
Under 60	17	9	3	0	9	7	1	0
60	4	22	17	2	3	16	19	2
61-90	0	5	9	6	0	5	11	10
91 and over	0	1	1	4	0	0	8	9
Total	21	37	30	12	12	28	39	21

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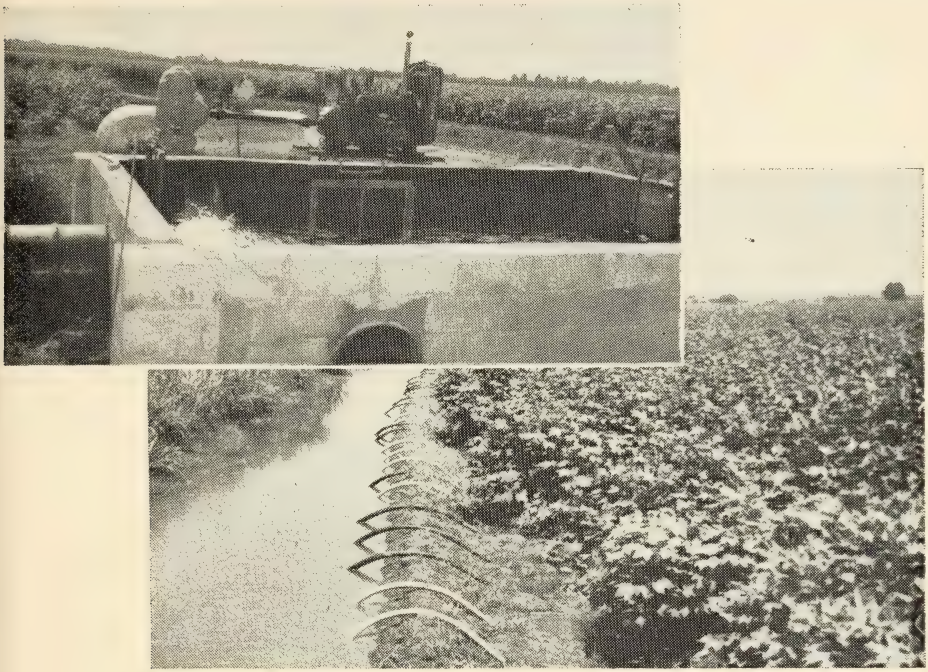

Investment and Operating Costs of Irrigation

in the Delta Area of Mississippi

A PROGRESS REPORT

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

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Summary

Supplemental irrigation has received increased attention as a production practice in the Delta of Mississippi in recent years. In many instances, use of the practice has been based on a costly "trial and error" approach. This study was designed to give some insight into the cost of developing sources of irrigation water and to compare investment and annual operating costs for alternative methods of distributing water.

When natural surface sources of water are conveniently located and properly used, they are cheaper than wells as a source of irrigation water. However, the dependability of a surface source of water is often an open question. Wells in the Delta area offer a dependable and fairly cheap source of irrigation water. It is possible to develop and equip a well delivering 2,000 gallons of water per minute for approximately $5,000. Annual pumping costs for such a well could be expected to average around $0.45 per acre-inch. For smaller wells, these pumping costs will increase; they may go as high as $1.00 per acre-inch. For large wells—those in the neighborhood of a pumping capacity of 2,500 gallons per minute, annual costs range from 25 to 35 cents per acre-inch.

Based on the 145 farms included in the study reported here, investment in irrigation equipment averaged $73 per acre irrigated for sprinkler systems, $57 for gated-pipe systems, $36 for siphon-tube systems, and $50 for other gravity systems. Average investment for the 145 farms was $56 per acre irrigated.

Annual operating costs per acre irrigated averaged as follows: Sprinkler systems, $18; gated-pipe systems, $18; siphon-tube systems, $8; and other gravity systems, $12. Average annual costs for all systems amounted to $15 per acre irrigated.

In appraising these costs it should be kept in mind that supplemental irrigation is relatively new in the Mississippi Delta and the majority of producers who are using it have had little or no previous experience. Both management and labor are "feeling their way" in the use of the practice and many problems have resulted. Optimum efficiency in the use of equipment and labor has not been attained. The **planning** and **management** of the individual operator continues to be the chief factor affecting labor requirements and costs.

As management and labor gain more knowledge and experience, efficiency in the use of irrigation would naturally be expected to occur. In addition to reducing the costs of irrigation, these increased efficiencies may also alter the cost relationships existing among the various distribution methods.

With present practices and techniques, and 1956 prices, an increase in yield of 255 pounds of seed cotton, 15 bushels of corn, or 7 bushels of soybeans per acre would be required to cover the direct and associated cost of two irrigations.

Supplemental Irrigation, Investment and Operating Costs in the Delta Area of Mississippi

By THOMAS E. TRAMEL, GRADY B. CROWE and J. F. ABEL, JR.[2]

An increasing interest in the use of supplemental irrigation as a production practice in humid areas has been evident for the last few years. In Mississippi alone, crop acreages irrigated excluding acreages of rice have increased from essentially none in 1949 to roughly 150,000 in 1956.

This increase reflects the accelerated search for new machines and new production techniques for improving production efficiency, which had its beginning during and immediately following World War II. In addition to its part in normal technological progress, supplemental irrigation is receiving increased attention for several reasons. Among these are: (1) the relatively widespread droughts that have occurred in humid production areas during critical growing periods in the last few years; (2) the generally favorable reports that have come from experience with the practice; (3) the availability of quality irrigation equipment; and (4) continued efforts on the part of producers to maintain total production on restricted land bases.

Considerable research information has been collected in the last few years on the agronomic and engineering phases of supplemental irrigation. However, little effort has been made to utilize this information to evaluate the relative profitableness of the practice. Farmers are investing considerable sums of money in irrigation equipment without the benefit of sound cost information on which to base their decisions.

It is the purpose of this progress report to present the economic phases of supplemental irrigation dealing with investment and annual operating costs. Comparisons are made of investment and operating costs for alternative sources of water and alternative methods of distributing water. It is anticipated that the findings below will ultimately be incorporated in a complete economic evaluation of the practice of supplemental irrigation, which will be presented in later reports.

Most of the data used in the study reported here was obtained by personal interviews with 145 farmers in the Mississippi Delta who used supplemental irrigation. Information was obtained from 22 farmers in 1954 and 123 farmers in 1956. To supplement the data collected from farmers, additional information was obtained from drilling companies, equipment dealers, and power suppliers.

Source of Water

Water for irrigation is obtained from both surface sources and wells. Most of the surface sources used are natural sources such as creeks, bayous, and lakes. Obviously, a dependable and conveniently located surface source of water is cheaper than a well. However, it must be re-

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[1] This report is part of a more comprehensive study of supplemental irrigation and its implications being conducted by the Mississippi Agricultural Experiment Station and the Farm Economics Research Division, Agricultural Research Service, U.S.D.A.

[2] Agricultural Economist, Mississippi Agricultural Experiment Station; Agricultural Economist, Farm Economics Research Division, ARS, USDA, located at the Delta Branch of the Mississippi Agricultural Experiment Station; and formerly Research Assistant, Department of Agricultural Economics, Mississippi Agricultural Experiment Station, respectively.

Table 1. Average rated capacity and investment[1] for wells of varying sizes, Delta Area, Mississippi, 1956.

Item	Type of power unit	
	Electric motor	Combustion engine
	Small[2]	
Number of wells	19	18
Rated capacity (g. p. m.)	717	588
Total investment (dollars)	2,480	2,030
	Medium[3]	
Number of wells	49	28
Rated capacity (g. p. m.)	1,998	1,975
Total investment (dollars)	4,550	5,060
	Large[4]	
Number of wells	9	3
Rated capacity (g. p. m.)	2,364	2,567
Total investment (dollars)	4,500	5,080

[1] Includes investment in pumps and power units.
[2] 2"-6" pumps.
[3] 8"-10" pumps.
[4] 12" pumps and over.

membered that, in many instances, the dependability of a surface source is inversely proportional to the number of farmers who think it dependable and are able to use it. Many streams have been pumped dry during periods of critical water needs. Location, too, is important. An investment of $1.00 to $1.25 per foot is required to move water through pipes. The use of open ditches requires less investment but expenses of maintenance and repair are incurred.

Wells have proved to be a dependable and reasonably cheap source of water in the Delta. Wells are usually drilled to a depth of 100 to 165 feet, averaging about 125 feet. They are shallow compared with depths in older irrigated areas. Water is usually reached at 15 to 22 feet, although the pumping level after draw-down varies greatly with the formation, it is usually no more than 30 to 45 feet.

Investment

Average investments for wells of varying sizes and for different sources of power are presented in Table 1. Smalls wells,[3] which are preferred by many who irrigate, cost roughly half as much as medium-sized or large wells but they deliver only about a third as much water. Wells equipped to deliver between 2,000 and 2,500 gallons per minute cost roughly $4,500 to $5,000, including the pump and power unit. From an investment standpoint, the source of power for the pump makes only a slight difference.

Operating Costs

Operating costs and related information for wells of different sizes are shown in Table 2. These operating costs include, in additon to variable costs, such fixed-cost items as depreciaton and interest on investment.

Fixed costs and fuel accounted for more than 90 percent of total operating costs, regardless of size of well or source of power. For pumps powered with electric motors, cost of electricity accounted for roughly 45 percent of operating costs and fixed charges for slightly more than 50 percent. For combustion engines, fuel costs were somewhat lower. They averaged 22 to 33 percent of operating costs. Fixed charges for wells equipped with pumps powered by combustion-type engines were well over 60 percent of the total annual costs.

Costs per hour of operation ranged from $1.16 for small wells with electric motors to $2.15 for large wells with combustion engines. The apparent lack of a

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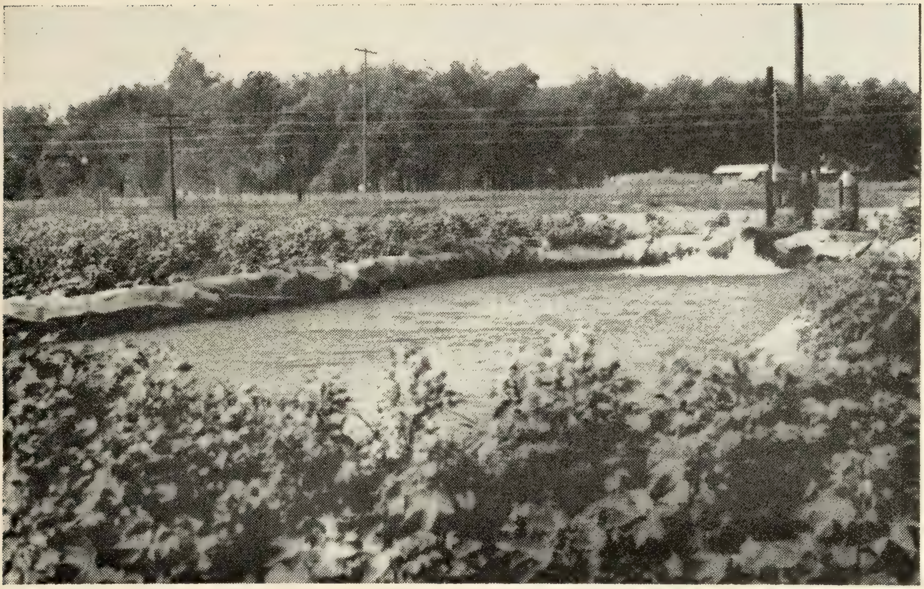
[3] For purposes of this report, wells are grouped into small, medium, and large sizes. Small wells are equipped with pumps ranging from 2" to 6" in size; medium wells from 8" to 10"; and large wells have pumps of 12" or more.



Typical well in the Delta.

pattern in these cost figures is a reflection of the extremely wide varation in amount of annual use. Pumps powered by combustion engines for both small and large wells were used only about 60 percent as much as pumps powered by electric motors. Less annual use results in a poorer distribution of overhead costs and increases hourly operating rates.

Only for medium-sized wells was the amount of annual use sufficiently comparable to allow a sound comparison of hourly operating costs between power sources. Combustion engines were cheaper in this instance, by $0.24 per hour—$1.84 compared with $2.08.

Costs per increment of water pumped declined rapidly as size of well increased. Cost per acre-inch pumped by electric motors dropped from $0.73 for small wells to $0.28 for large wells. The higher pumping cost per acre-inch indicated for small and large wells powered by combustion engines is a result of less annual use. Had these wells been used as much as those operated with electricity, this cost differential between sources of power would have tended to disappear. In fact, costs per acre-inch might have been less for wells with which combustion engines were used, as was the case for medium-sized wells.

Distribution Systems

Thus far this report has dealt only with costs associated with pumping water from wells. Once water has been pumped to the top of the ground, one or more of several systems of distribution may be used to transport and apply it to the crops to be irrigated. For purposes of this report, alternative methods of applying water are grouped into four categories: (1) sprinklers, (2) gated pipes, (3) siphon tubes, and (4) other gravity methods.

Sprinkler irrigation actually simulate

rain. Water is transported from the source to the field either in pipes or in open ditches and delivered through spray nozzles to the crop. The sprinkler system is composed of a pump, pipe fittings, and risers to which the nozzles are attached. Water is discharged under pressure through the nozzles so that it breaks up into small drops and covers an area uniformly. Usually, little or no land preparation is necessary for the use of sprinkler irrigation.

Gated pipe is a method of furrow or gravity irrigation. Water is transported from the source to the field by either open ditches or conveyance pipes and delivered to the crop through a gate or opening in the application pipe corresponding to each furrow. Once the water is discharged at the head of the furrow, it flows

Table 2. Annual costs[1] of pumping water from 126 wells of varying sizes, Delta Area, Mississippi, 1956.

Item	Type of power unit	
	Electric motor	Combustion engine
	Small[2]	
Number of wells	19	18
Hours operated annually	511	302
Cost of fuel or electricity (dollars)	267	85
Cost of repairs (dollars)	12	46
Cost of motor oil and other lubricants (dollars)	4	6
Interest on investment (dollars)	62	51
Depreciation on wells, pumps, and power units (dollars)	248	203
Total annual cost (dollars)	593	391
Annual cost per hour (dollars)	1.16	1.29
Cost per acre-inch (dollars)	.73	1.00
	Medium[3]	
Number of wells	49	28
Hours operated annually	512	526
Cost of fuel or electricity (dollars)	482	249
Cost of repairs (dollars)	9	78
Cost of motor oil and other lubricants	4	9
Interest on investment (dollars)	114	126
Depreciation on wells, pumps, and power units (dollars)	455	506
Total annual costs (dollars)	1,064	968
Annual cost per hour (dollars)	2.08	1.84
Cost per acre-inch (dollars)	.47	.42
	Large[4]	
Number of wells	9	3
Hours operated annually	768	482
Cost of fuel or electricity (dollars)	532	338
Cost of repairs (dollars)	19	57
Cost of motor oil and other lubricants (dollars)	5	5
Interest on investment (dollars)	113	127
Depreciation on wells, pumps, and power units (dollars)	450	508
Total annual costs (dollars)	1,119	1,035
Annual cost per hour (dollars)	1.46	2.15
Cost per acre-inch (dollars)	.28	.38

[1] Depreciation calculated at the rate of 10 percent of the replacement cost and interest on investment at 5 percent on one-half replacement cost.

[2] 2"-6" pumps.

[3] 8"-10" pumps.

[4] 12" pumps and over.

along the row by gravity. Various types of gates permit controlling the flow of water. Although use of this method may require some land preparation, in general, it reduces the cost of land preparation considerably below that necessary for other gravity methods.

The use of siphon tubes is another furrow or gravity-irrigation method. Water is transported from the source to the field in pipes or open ditches and delivered to the crop from a ditch at the head of the field by means of siphon tubes. Usually an aluminum, plastic or rubber siphon tube, which may vary in size from three-fourths of an inch to two inches, is placed in each furrow. Land must be properly leveled and graded if this method of irrigation is to be used effectively.

Other gravity-irrigation methods, as used here, include flood and shovel irrigation. The shovel system makes possible furrow irrigation with a minimum of equipment. Ditches at the head of a field are cut with a shovel and water is allowed to flow down the furrows by gravity. Flood irrigation has a number of modifications. In wild flooding, water is turned loose at the highest point in a field and allowed to run to the lowest points. This system is used mainly for pastures and small grain. In contour-check flooding, dikes are built along contours and the entire area encompassed by a dike is flooded, much as is done in irrigating rice.

Of the four systems discussed, the gated pipe was the most widely used on the 145 farms studied. Slightly over 29,000 acres of crops were irrigated on these farms. About 32 percent of this acreage was irrigated by use of gated pipe, 28 percent by sprinklers, 15 percent by siphon tubes, and 25 percent by other gravity methods. An average of approximately two applications of water was made. More

Sprinkler irrigation.

Siphon irrigation.

than 70 percent of the acreage irrigated was in cotton. Soybeans accounted for approximately 18 percent of the acreage and corn for about 5 percent. The rest was in pasture and miscellaneous crops.

REPLACEMENT COSTS

A fundamental consideration that each farmer must face in deciding whether to equip his farm for supplemental irrigation is the relatively high initial investment required. In many instances the type of system he chooses and the extent to which he prepares for irrigation is influenced by his capital position. The pages that follow will attempt to give some insight as to the investment required for different irrigation systems using alternative sources of water, as well as a breakdown of the cost of individual items.

Differences in initial cost for the different systems should not be interpreted as differences an individual farmer could expect to incur, however. In deciding which type of system to buy, each farmer chose the system that appeared to fit his individual situation. Thus replacement costs for the different systems must be interpreted only as average for those farms having particular systems.

Sprinkler Systems

Sprinkler irrigation was used on roughly a third of the farms included in the study reported here. This method was used on farms where both wells and surface sources supplied irrigation water. The effect on investment of using alternative water sources is taken into account in the discussion below.

Farms Having Wells Only. Total replacement cost chargeable to sprinkler irrigation on 28 farms, where water was supplied by wells, averaged $12,824 per farm, $83 per acre irrigated, and $39 per acre once-over-equivalent (Table 3). Pipes used in transporting and distributing irrigation water represented the largest single investment item, accounting for 40 percent of total investment in sprinkler

Table 3. Investment per farm for sprinkler-irrigation equipment, conveyance structures, and land forming, 28 farms having wells only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 28 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	28	.86	3,982	3,982
Other pumps and power units	23	1.10	2,155	1,770
Trailers	21	-----	81	61
Pipes	28	-----	5,143	5,143
Other equipment	28	-----	1,366	1,366
Land forming	8	-----	291	83
Conveyance structures	16	-----	410	234
Land lost	10	2.59 acres	518	185
Total	—	—	—	12,824
Total per acre irrigated	—	—	—	83
Total per acre once-over-equivalent	—	—	—	39

[1] Average acreage irrigated 155; acres once-over-equivalent 325.

equipment. The average well installation on these farms cost $4,630. However, as only 86 percent of the water pumped from the wells was distributed by sprinklers, only $3,982 of this investment cost is properly chargeable to sprinkler irrigation. Average investment in wells, well pumps, and power units on these 28 farms accounted for 31 percent of the total investment; other pumps and power units accounted for another 14 percent. Equipment used for sprinkler irrigation, other than pumps and power units, nozzles, risers, valves, plugs, elbows, and so on represented 11 percent of the total. Investment in such items as trailers, land forming, conveyance structures, and land lost in ditches was relatively unimportant. It should be pointed out, however, that in many instances drainage ditches already available were used to transport water. If it were necessary to build a complete set of ditches for irrigation purposes, this item would represent a sizeable expense. On these 28 farms, water was applied by the sprinkler system 2.1 times to an average of 155 acres.

Farms Having Surface Sources of Water Only. In many instances natural surface sources such as creeks, bayous, and lakes are used to supply irrigation water. On 21 farms using such sources, total investment in sprinkler irrigation equipment averaged $9,396 per farm, $59 per acre irrigated, and $29 per acre once-over-equivalent (Table 4). Pipes were again the largest single item of investment; they accounted for 55 percent of the total and other equipment for 14 percent. On these 21 farms, an average of 160 acres was irrigated an average of 2.0 times by use of sprinkler equipment.

The main differences in investment between these farms and those using well water are in investment in well installation and in other pumps and power units. Although on farms using surface water the investment in other pumps and power units was considerably higher, it was not high enough to offset the cost of the well installations. As both groups of farms irrigated approximately the same acreage, it is evident that the surface sources of water were sufficiently dependable and conveniently enough located to make them source of irrigation water.

Farms Having Both Sources of Water. Only two farms were observed on which both wells and surface sources of water

Table 4. Investment per farm for sprinkler irrigation equipment, conveyance structures, and land forming, 21 farms having surface sources of water only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment	
			Average per farm reporting	Average for 21 farms
	Number	Number	Dollars	Dollars
Pumps and power units	21	1.56	2,625	2,625
Trailers	16	---	100	76
Pipes	21	---	5,168	5,168
Other equipment	21	---	1,293	1,293
Land forming	4	---	499	95
Conveyance structures	7	---	387	129
Land lost	4	.26 ac	53	10
Total	---	---	---	9,396
Total per acre irrigated	---	---	---	59
Total per acre once-over-equivalent	---	---	---	29

[1] Average acreage irrigated 160; acres once-over-equivalent 328.

were used in conjunction with sprinkler irrigation. On these farms, replacement cost averaged $17,789 per farm, $79 per acre irrigated, and $34 per acre once-over-equivalent (Table 5). Pipes accounted for 49 percent of the total investment, other pumps and power units for 23 percent, well installations for 16 percent, and other equipment for 11 percent. These two farms irrigated an average of 224 acres 2.4 times by use of sprinkler equipment. Items of investment on these farms are about what would be expected in light of the investment on farms using either one source of water or the other. Well costs are not as high on these farms as on farms that use wells exclusively. Neither are costs of other pumps and power units as high as on farms that depend entirely on surface sources of water.

It will be noted that very little capital was invested in land forming on farms using sprinkler irrigation. In fact, this item averaged only $95 per farm for the entire group.

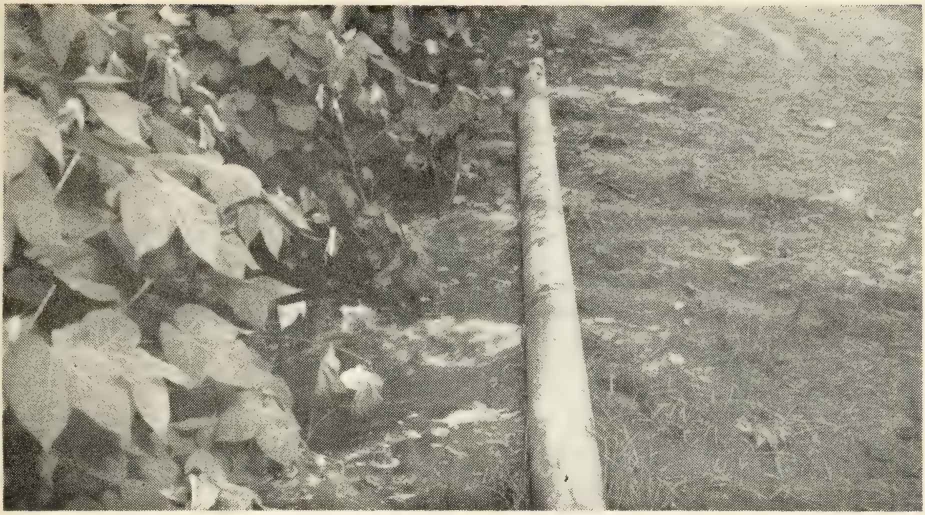
Regardless of source of water investment per acre irrigated by sprinkler systems averaged $73 per acre for the 51 farms on which sprinkler systems were used. For a complete tabulation of investment in sprinkler equipment for this group of farms, see Appendix Table 1.

Gated Pipe

As previously stated, gated pipe was the most common method of irrigation found in this study. It was used on almost half the farms included.

Farms Having Wells Only. On 42 farms using gated pipe and having wells only as a source of water, total replacement cost chargeable to gated pipe irrigation averaged $8,001 per farm, $61 per acre irrigated, and $29 per acre once-over-equivalent (Table 6). Well installations accounted for 44 percent of the total replacement costs. Large quantities of pipe for transportation and distribution of water are needed for irrigation with gated pipe, as well as with sprinkler systems, and pipe accounted for 28 percent of the total capital outlay. Other pumps and power units made up 14 percent of the investment. Acres irrigated by use of gated pipe averaged 132 for this group of farms: times irrigated averaged 2.1.

It will be noted that about half the farms using gated pipe had an investment in land forming, for an average of almost $500 per farm for the 42 farms. Although this figure is high compared with the figure for sprinkler irrigation, it is still relatively low because when farmers first begin irrigating they irrigate first the



Gated pipe.

land that requires a minimum of land forming. As irrigation is expanded to more acres, this item of investment can be expected to increase materially.

Farms Having Surface Sources of Water Only. On 24 farms on which surface sources of water only were used investment in gated-pipe irrigation equipment averaged $4,558 per farm, $48 per acre irrigated, and $30 per acre once-over-equivalent (Table 7). This represents a considerable reduction in investment per acre over farms on which wells were used —$48 compared with $61. However, on the average this group irrigated only 94 acres 1.6 times by gated pipe. So investment per acre once-over-equivalent was about the same as for the group of farms on which wells were used.

Farms Having Both Wells and Surface Sources of Water. Only 5 farmers who were using gated-pipe irrigation were found to be obtaining irrigation water from both wells and surface sources. However, they were operating large farms and irrigating an average of 328 acres 1.58 times by gated pipe for a once-over-equivalent acreage of 518 (Table 8).

On these farms, total investment in irrigation equipment averaged $17,604 per farm, $54 per acre irrigated, and $34 per acre once-over-equivalent. As would be expected, investment per acre irrigated fell between that for farms using wells only and for those using surface sources of water only. The chief item of investment on these farms was well installations, which accounted for 31 percent of the total investment. Pipes accounted for 27 percent of the total and pumps and power units other than those for wells accounted for 21 percent. On these 5 farms, land forming was a significant item of investment; it amounted to $1,518 dollars per farm and accounted for 9 percent of the total investment. Land lost in preparing for irrigation was also an important item of investment; it averaged slightly over 9 acres per farm reporting and amounted to an average of $1,466 per farm for the 5 farms.

Investment per acre irrigated by gated pipe regardless of source of irrigation water amounted to $57. This is considerably less than the investment of $73 per acre indicated for sprinkler systems. For a complete tabulation of investment in gated-pipe equipment for the 71 farms using this system, see Appendix Table 2.

Siphon Tubes

Siphon tube irrigation is a popular type of gravity irrigation; it was used on about 20 percent of the farms included in the study reported here.

Farms Having Wells Only. Where wells supplied irrigation water, the total replacement cost chargeable to siphon-tube irrigation averaged $5,942 per farm, $39 per acre irrigated, and $15 per acre once-over-equivalent (Table 9). These investment figures are considerably lower than those indicated for sprinklers and gated pipe.

Of the total investment for this system of irrigation, well installations accounted for 54 percent; land forming for 21 percent; and land lost for 10 percent. Pipe and other pieces of equipment were relatively unimportant items of investment.

Land forming was reported on almost half the farms on which siphon tube irrigation was used and for these farms this item averaged $2,592 per farm. Fifteen of the farms reported an average of almost 4 acres per farm lost in preparing for irrigation. This involved an average cost of $618 per farm for the 19 farms on

Table 5. Investment per farm for sprinkler irrigation equipment, conveyance structures, and land forming, 2 farms having wells and surface sources of water, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 2 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	2	.60	2,786	2,786
Other pumps and power units	2	1.21	4,054	4,054
Trailers	2	----	21	21
Pipes	2	----	8,691	8,691
Other equipment	2	----	1,978	1,978
Land forming	1	----	512	256
Conveyance structures	1	----	6	3
Land lost	0	----	----	----
Total	----	----	----	17,789
Total per acre irrigated	----	----	----	79
Total per acre once-over-equivalent	----	----	----	34

[1] Average acreage irrigated 224; acres once-over-equivalent 527.

Table 6. Investment per farm for gated-pipe irrigation equipment, conveyance structures, and land forming, 42 farms having wells only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 42 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	42	.87	3,505	3,505
Other pumps and power units	36	1.01	1,308	1,121
Trailers	18	----	68	29
Pipes	42	----	2,220	2,220
Other equipment	37	----	305	269
Land forming	20	----	1,012	482
Conveyance structures	18	----	357	153
Land lost	19	2.46 ac.	491	222
Total	----	----	----	8,001
Total per acre irrigated	----	----	----	61
Total per acre once-over-equivalent	----	----	----	29

which siphon tubes were used and which had only wells as sources of water. For this group of farms, acres irrigated by siphon tubes averaged 151; times irrigated averaged 2.7.

Farms Having Surface Sources of Water Only. Total investment in siphon tube irrigaton, for farmers who obtain irrigation water from surface sources only, averaged $3,618 per farm, $30 per acre irrigated, and $17 per acre once-over-equivalent (Table 10). This is a clear-cut case of natural surface sources being cheaper to develop when they are available.

Pumps and power units represent 49 percent of the total investment for this group of farms, land forming 32 percent, and pipes 11 percent. The greater investment in pipes is a result of their use for transporting water from surface sources to points of distribution. Land forming was reported on half the farms in this group and for those reporting represented an average cost of $2,288 per farm. Land lost amounted to less than one acre per farm reporting and averaged only $133 per farm for the group of farms using siphon tubes and having surface sources. For this group of farms, an average of

Table 7. Investment per farm for gated-pipe irrigation equipment, conveyance structures, and land forming, 24 farms having surface sources of water only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 24 farms
	Number	Number	Dollars	Dollars
Pumps and power units	24	1.10	1,602	1,602
Trailers	18	------	59	44
Pipes	24	------	2,328	2,328
Other equipment	24	------	313	313
Land forming	7	------	648	189
Conveyance structures	6	------	64	16
Land lost	4	1.98 ac.	396	66
Total	----	------	--------	4,558
Total per acre irrigated	----	------	--------	48
Total per acre once-over-equivalent	----	------	--------	30

[1] Average acreage irrigated 94; acres once-over-equivalent 152.

Table 8. Investment per farm for gated-pipe irrigation equipment, conveyance structures, and land forming, 5 farms having wells and surface sources of water, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 5 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	5	1.13	5,399	5,399
Other pumps and power units	5	3.06	3,691	3,691
Trailers	4	------	115	92
Pipes	5	------	4,699	4,699
Other equipment	5	------	253	253
Land forming	5	------	1,518	1,518
Conveyance structures	1	------	2,430	486
Land lost	4	9.16 ac.	1,832	1,466
Total	----	------	--------	17,604
Total per acre irrigated	----	------	--------	54
Total per acre once-over-equivalent	----	------	--------	34

[1] Average acreage irrigated 328; acres once-over-equivalent 518.

121 acres was irrigated an average of 1.8 times by use of siphon tubes.

Farms Having Both Wells and Surface Sources of Water. Only three farms using the siphon-tube irrigation and both wells and surface sources were encountered in this study. On these farms total investment chargeable to the siphon-tube system averaged $5,307 per farm, $30 per acre irrigated, and $15 per acre once-over-equivalent (Table 11). The main items of investment were: wells, 41 percent; other pumps and power units, 22 percent; pipes 12 percent; land forming, 12 percent; and land lost, 9 percent.

In general wells were large on these farms, costing an average of $6,624. However, as they were used also in conjunction with other distribution systems, only a third of this amount was properly chargable to siphon-tube irrigation. Land forming which was reported on all three farms, averaged $647 per farm and land lost averaged $455 per farm. Investment per acre irrigated for this system compares favorably with any other system included in this study. For these three farms, an average of 174 acres was irrigated with siphon-tubes an average of 2.0 times.

Table 9. Investment per farm for siphon-irrigation equipment, conveyance structures, and land forming, 19 farms having wells only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 19 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	19	.92	3,194	3,194
Other pumps and power units	12	1.14	706	446
Trailers	7	-----	38	14
Pipes	5	-----	456	120
Other equipment	15	-----	170	134
Land forming	9	-----	2,592	1,228
Conveyance structures	13	-----	275	188
Land lost	15	3.92 ac.	783	618
Total	---	-----	-------	5,942
Total pre acre irrigated	---	-----	-------	39
Total per acre once-over-equivalent	---	-----	-------	15

[1]Average acreage irrigated 151; acres once-over-equivalent 404.

Table 10. Investment per farm for siphon-irrigation equipment, conveyance structures, and land forming, 8 farms having surface sources of water only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 8 farms
	Number	Number	Dollars	Dollars
Pumps and power units	8	1.64	1,784	1,784
Trailers	2	-----	12	3
Pipes	7	-----	456	399
Other equipment	6	-----	83	62
Land forming	4	-----	2,288	1,144
Conveyance structures	3	-----	248	93
Land lost	6	.88 ac.	177	133
Total	---	-----	-------	3,618
Total per acre irrigated	---	-----	-------	30
Total per acre once-over-equivalent	---	-----	-------	17

[1]Average acreage irrigated 121; acres once-over-equivalent 217.

For complete listing of investment items associated with siphon-tube irrigation regardless of the source of irrigation water, see Appendix Table 3.

Other Gravity-Irrigation Methods

Other gravity-irrigation methods, as was pointed out earlier, include both shovel- and flood-irrigation systems. These methods of irrigation were used on approximately 38 percent of the farms studied.

Farms Having Wells Only. On 39 farms using other gravity methods of irrigation and obtaining irrigation water from wells, total investment associated with this system of irrigation averaged $8,833 per farm, $54 per acre irrigated, and $32 per acre once-over-equivalent (Table 12). The main items of investment were: wells, which accounted for 42 percent of the total investment; land forming for 18 percent; pipes for 14 percent; other pumps and power units for 11 percent; and land lost for 9 percent.

Again the significance of land prepara-

Table 11. Investment per acre for siphon-irrigation equipment, conveyance structures, and land forming, 3 farms having wells and surface sources of water, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 3 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	3	.33	2,186	2,186
Other pumps and power units	3	1.22	1,183	1,183
Trailers	2	------	69	46
Pipes	2	------	942	628
Other equipment	3	------	162	162
Land forming	3	------	647	647
Conveyance structures	0	------	--- ----	--------
Land lost	3	2.28 ac	455	455
Total	----	------	--------	5,307
Total per acre irrigated	----	------	--------	30
Total per acre once-over-equivalent	----	------	--------	15

[1] Average irrigated 174; acres once-over-equivalent 348.

Table 12. Investment per farm for other gravity systems irrigation equipment, conveyance structures, and land forming, 39 farms having wells only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 39 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	39	1.00	3,674	3,674
Other pumps and power units	24	1.28	1,534	944
Trailers	13	-----	51	17
Pipes	30	-----	1,599	1,230
Other equipment	29	-----	169	126
Land forming	17	-----	3,746	1,633
Conveyance structures	23	------	655	386
Land lost	22	7.30 ac.	1,459	823
Total	—	-----	------	8,833
Total per acre irrigated	—	-----	-------	54
Total per acre once-over-equivalent	---	-----	------	32

[1] Average acreage irrigated 165; acres once-over-equivalent 277.

tion as an investment item with gravity irrigation is noted. On 17 of the 39 farms land forming was reported to the extent of $3,746 per farm. Land lost which was reported on 22 farms, averaged more than 7 acres and amounted to an average of $1,459 per farm. The relatively high investment in pipes indicates a significant use of this equipment for transporting water from the source to points of distribution. Acres irrigated by other gravity methods averaged 165 for the 39 farms; times over averaged 1.7.

Farms Having Surface Sources of Water Only. On 15 farms on which other gravity systems of irrigation were used, surface sources of water were used exclusively. On these farms, total replacement costs chargeable to other gravity irrigation averaged $1,586 per farm, $29 per acre irrigated, and $20 per acre once-over-equivalent (Table 13). Again the practical use of surface water for irrigation is demonstrated as cheaper than water from wells. Although investment per farm in other gravity-method systems was lower than for other groups studied, the acreage irrigated was small also. Only 54 acres were irrigated by these systems per farm. Water was applied to this acreage an average of 1.5 times.

The main items of investment for this method of irrigation were pumps and power units, accounting for 42 percent of the total and pipes, representing 34 percent. Land lost accounted for 10 percent of the total investment and other equipment for 6 percent. Costs of land forming were

Table 13. Investment per farm for other gravity systems, irrigation equipment, conveyance structures, and land forming, 15 farms having surface sources of water only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 15 farms
	Number	Number	Dollars	Dollars
Pumps and power units	15	.65	667	667
Trailers	7	------	21	10
Pipes	14	------	579	540
Other equipment	13	------	113	98
Land forming	5	------	171	57
Conveyance structures	6	------	135	54
Land lost	6	2.00 ac.	400	160
Total	----	------	-------	1,586
Total per acre irrigated	----	------	-------	29
Total per acre once-over-equivalent	----	------	-------	20

[1] Average acreage irrigated 54; acres once-over-equivalent 79.

Table 14. Investment per farm for other gravity systems, irrigation equipment, conveyance structures, and land forming, 1 farm having well and surface sources of water, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 1 farm
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	1	.13	660	660
Other pumps and power units	1	.65	169	169
Land lost	1	.39 ac	78	78
Total	----	------	-------	907
Total per acre irrigated	----	------	-------	8
Total per acre once-over-equivalent	----	------	-------	8

[1] Average acreage irrigated 120; acres once-over-equivalent 120.

Gravity irrigation.

not significant.

Farms Having Both Wells and Surface Sources of Water. Only one farmer who uses other gravity irrigation was found to be obtaining irrigation water from both wells and surface sources. As one observation could be misleading, it was omitted from this discussion. However, the data are presented in Table 14. For a complete tabulation of investment items for other gravity systems, regardless of source of irrigation water, see Appendix Table 4.

For a more comprehensive look at the investment picture, see Table 15, which shows total investment per acre in irrigation equipment for all combinations of distribution systems and water sources. These investments range from a high of $83 for sprinkler systems and well water to a low of $30 per acre for siphon tubes and surface water sources. For a complete listing of investment items by types of distribution system and by sources of irrigation water, see Appendix Tables 1-8.

Operating Costs

Annual costs of irrigation include interest on investment, depreciation, and maintenance of leveled land and conveyance structures,[4] as well as "out of pocket" costs such as those for electricity, fuel, repairs, lubricants, and labor. These and other annual cost items for the different irrigation systems are presented in this section. As was the case with investments, however, they should be interpreted only as average annual costs on the farms studied. Differences between costs for the different systems should not be interpreted as differences in costs an individual could expect to incur between systems for a given situation.

Farms Having Wells Only. On farms using wells as a source of water, annual irrigation costs per acre irrigated varied from a high of $20 for sprinkler systems

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[4] Ten percent of the investment in land leveling and conveyance structures is included in depreciation as an annual charge for maintenance.

Table 15. Total investment in irrigation equipment per acre irrigated by type of distribution system used and source of irrigation water, Delta Area, Mississippi, 1956.

	Type of distribution system				
Source of water	Sprinkler	Gated pipe	Siphon	Other gravity methods	All systems
			Dollars		
Wells only	83	61	39	54	60
Surface sources only	59	48	30	29	49
Both wells and surface sources	79	54	30	8	51
All farms studied	73	57	36	50	56
			No. farms		
Wells only	28	42	19	39	89
Surface sources only	21	24	8	15	50
Both wells and surface sources	2	5	3	1	6
All farms studied	51	71	30	55	145

and gated pipe to a low of $9 for siphon tubes (Tables 16). Costs per acre once-over-equivalent ranged from $10 for sprinklers to $3 for siphon tubes. There was little difference between operating costs for sprinklers and gated pipe. Both require sizeable investments in equipment and labor requirements are higher than for the other systems. Siphon-tube irrigation was much cheaper than irrigation by these two systems largely because of lower investment resulting in smaller fixed costs, and because of lower labor requirements. However, as was pointed out earlier, the proper use of siphon-tube irrigation requires that land be properly prepared. In the initial stages of adoption of the practice of supplmental irrigation land that required little or no preparation was selected. As irrigation is extended to additional acreages, more land preparation will be needed and these annual costs are likely to rise somewhat.

The main items of annual expense for all distribution systems were depreciation, labor and fuel. The proportion of total operating costs accounted for by depreciation ranged from 30 percent for gated pipe to 45 percent for siphon tubes and other gravity systems. Labor costs ranged from 13 percent of the total for other gravity systems to 37 percent for gated pipe. Fuel or electricity was roughly 20 percent of total costs for each of the different systems.

Farms Having Surface Sources of Water Only. On farms using surface water only, annual costs of irrigation per acre irrigated were slightly lower than for farms having wells, but they followed the same general pattern among systems. Total costs per acre irrigated ranged from a high of $16 for sprinklers to a low of $8 for siphon tubes. Costs per acre once-over-equivalent ranged from $9 for gated pipe to $5 for siphon tubes. Depreciation represented the largest single item of annual costs.

Farms Having Wells and Surface Sources of Water. On farms using both sources of irrigation water, annual irrigation costs per acre irrigated ranged from a high of $18 for sprinklers to $7 for siphon tubes.[5] The general pattern of comparative costs among systems was much the same as the two situations discussed above. In general, these comparisons reflect lower costs from the use of surface sources of water and otherwise indicate little effect of source of water on annual operating costs for the various distribution systems.

All Farms. A comparison of annual irrigation costs for alternative application systems regardless of source of irrigation water is also presented in Table 16. Annual irrigation costs per acre irrigated

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[5] Ignoring the one farm using other gravity systems.

Table 16. **Annual cost of irrigation by type of system, Delta Area, Mississippi, 1956.**[1]

Item	Type of system				
	Sprinkler	Gated pipe	Siphon	Other gravity systems	All systems
	Dollars				
	Farms having wells only				
Fuel and electricity	611	452	286	417	650
Repairs, oil and grease	226	220	83	193	277
Depreciation	1,282	800	594	883	1,295
Interest on investment	321	200	149	221	324
Labor	682	966	219	262	831
Total	3,122	2,638	1,331	1,976	3,377
Total per acre irrigated	20	20	9	12	16
Total per acre once-over-equivalent	10	9	3	7	8
	Farms having surface sources only				
Fuel and electricity	488	201	181	72	352
Repairs, oil, and grease	209	132	135	119	207
Depreciation	940	456	362	159	719
Interest on investment	235	114	90	40	180
Labor	695	441	211	147	581
Total	2,567	1,344	979	537	2,039
Total per acre irrigated	16	14	8	10	14
Total per acre once-over-equivalent	8	9	5	7	8
	Farms having wells and surface sources				
Fuel and electricity	982	848	327	71	1,210
Repairs, oil, and grease	326	333	116	9	446
Depreciation	1,779	1,760	531	91	2,342
Interest on investment	445	440	133	23	585
Labor	565	1,808	164	269	1,822
Total	4,097	5,189	1,271	463	6,405
Total per acre irrigated	18	16	7	4	14
Total per acre once-over-equivalent	8	10	4	4	8
	All farms studied				
Fuel and electricity	575	395	262	316	570
Repairs, oil, and grease	223	198	100	170	260
Depreciation	1,161	752	526	671	1,140
Interest on investment	290	188	131	168	285
Labor	683	848	211	231	786
Total	2,932	2,381	1,230	1,556	3,041
Total per acre irrigated	18	18	8	12	15
Total per acre once-over-equivalent	9	9	4	7	8

[1] See Table 15 for number of farms in each classification.

ranged from $18 for sprinklers and gated pipe to $8 for siphon tubes and averaged $15 for all systems. Costs per acre once-over-equivalent ranged from $9 for sprinklers and gated pipe to $4 for siphon tubes averaged $8 for all systems. The lower cost of siphon-tube irrigation is clearly established in this comparison, as well as in the others presented above. Depreciation and labor are again shown to be the two main items of annual cost.

In appraising investments and costs associated with alternative systems of distributing irrigation water as reported herein, two major considerations should be kept in mind. First, this is a progress report dealing with the initial findings in a broad and comprehensive study of supplemental irrigation. The final report will contain a more thorough and complete economic analysis of the practice. These preliminary findings are released at this time only because of the extreme interest in the subject.

Supplemental irrigation is relatively new in the Mississippi Delta and the majority of producers who are using it have had little or no previous experience. Both management and labor are "feeling their way" in the use of the practice and many inefficiencies have resulted. Exact patterns and techniques in the use of equipment and labor have not yet crystalized. The planning and management of the individual operator has continued to be the chief factor affecting labor requirements and costs. This is evident from the fact that the more efficient operators using each application method had lower costs than the bulk of the operators using any one method.

As management gains more knowledge and labor more experience, efficiency in the use of irrigation would naturally be expected to occur. In addition to reducing the costs of irrigation, these increased efficiencies may also alter the cost relationships that exist among the various distribution methods.

Production Responses Necessary to Cover Irrigation Costs

Sufficient information to permit a complete costs and returns evaluation of supplemental irrigation is not available. However, some insight into the economics of the problem can be gained by estimating the yield responses necessary to cover the costs of using the practice. In addition to the direct cost of irrigation, usually other costs are associated with its use. A prime illustration of these associated costs is the expense of harvesting and processing any increase in yields. Estimates of production response necessary to cover irrigation and associated costs for selected crops are presented in this section of the report.

Cotton

In cotton production, added costs associated with the use of supplemental irrigation are represented by additional poisoning, hoeing, and cultivation and by harvesting and ginning the increased yield. For the year studied, farmers estimated that irrigating cotton resulted in roughly three additional poisonings, something less than one complete hoeing, and a small amount of extra cultivation. Reduced to dollar values these three items make up additional costs of roughly $9.50 per acre. Assuming two irrigations,[6] the direct costs of irrigation amount to an average of $16.00 per acre (average costs for all irrigation methods studied).

Assuming a 36-percent lint turnout, lint cotton worth 33.3 cents per pound[7], cottonseed worth $49.50 per ton[7], and picking,

[6] Cotton was irrigated an average of slightly over 2 times per acre on all farms studied.

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[7] Average price received by Mississippi farmers in 1956. **Agricultural Prices,** U. S. Department of Agriculture, AMS, Washington, D. C., January-December, 1956.

hauling, and ginning to cost $4.10 per hundredweight, a pound of seed cotton would be worth 10 cents in the field. Thus an increase in yield of 255 pounds of seed cotton per acre would have been required to cover irrigation and associated costs.

Corn

The only additional costs associated with irrigated corn production is that of harvesting the increased yield. Earlier studies indicate that for crops harvested mechanically, increases in yield result in only small additional harvesting costs.[8]

Assuming two irrigations[10] at a cost of of 4 cents per bushel and a market price for corn of $1.14 per bushel,[9] a bushel of corn would be worth $1.10 in the field.

Assumng two irrigations[10] at a cost of $16.00 per acre for the season, an increase in yield of approximately 15 bushels would be required to cover irrigation and associated costs.

Soybeans

In producing soybeans as in producing corn, the only indirect cost attributable to irrigation is that of harvesting increased yields. As soybeans are harvested entirely with machines, these added costs are small. Assuming an additional harvesting cost of 8 cents per bushel and a market price of 2.33 per bushel,[11] a bushel of soybeans would be worth $2.25 in the field. Assuming two irrigations[12] at a cost of $16.00 per acre, an increased yield of slightly over 7 bushels per acre would be necessary to cover the full costs of supplemental irrigation.

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[8] Specified Production Costs for Cotton and Alternative Crops, Yazoo-Mississippi Delta, by Grady B. Crowe, Mississippi Agricultural Experiment Station and Production Economics Research Branch, Stoneville, Miss., March, 1956.

[9] Average price received by Mississippi Farmers in 1956. **Agricultural Prices, op. cit.**

[10] Corn was irrigated an average of 2 times on all farms studied.

[11] Average prices received by Mississippi farmers in 1956, **Agricultural Prices, Op. Cit.**

[12] Soybeans were irrigated an average of 1.5 times on all farms studied.

Appendix Tables

Appendix Table 1. Investment per farm for sprinkler-irrigation equipment, conveyance structures, and land forming, 51 farms, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 51 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	30	.84	3,902	2,295
Other pumps and power units	46	1.31	2,452	2,212
Trailers	39	......	86	66
Pipes	51	......	5,292	5,292
Other equipment	51	......	1,360	1,360
Land forming	13	......	373	95
Conveyance structures	24	......	386	182
Land lost	14	1.93 ac.	386	106
Total	....	......	....	11,608
Total per acre irrigated	....	......	....	73
Total per acre once-over-equivalent	....	......	....	35

[1] Average acreage irrigated 160; acres once-over-equivalent 334.

Appendix Table 2. Investment per farm for gated-pipe irrigation equipment, conveyance structures, and land forming, 71 farms, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 71 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	47	.90	3,707	2,454
Other pumps and power units	65	1.20	1,600	1,465
Trailers	40	......	69	39
Pipes	71	......	2,431	2,431
Other equipment	66	......	304	283
Land forming	32	......	1,012	456
Conveyance structures	25	......	369	130
Land lost	27	3.38 ac.	676	257
Total	....	......	....	7,515
Total per acre irrigated	....	......	....	57
Total per acre once-over-equivalent	....	......	....	30

[1] Average acreage irrigated 133; acres once-over-equivalent 253.

Appendix Table 3. Investment per farm for siphon, irrigation equipment, conveyance structures, and land forming, 30 farms, Delta Area, Mississippi.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 30 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	22	.84	3,056	2,241
Other pumps and power units	23	1.32	1,143	876
Trailers	11	------	38	14
Pipes	14	------	525	245
Other equipment	24	------	147	118
Land forming	16	------	2,152	1,148
Conveyance structures	16	------	270	144
Land lost	24	2.96 ac.	591	472
Total	----	------	--------	5,258
Total per acre irrigated	----	------	--------	36
Total per acre once-over-equivalent	----	------	--------	15

[1] Average acreage irrigated 145; acres once-over-equivalent 349.

Appendix Table 4. Investment per farm for other gravity systems irrigation equipment, conveyance structures, and land forming, 55 farms, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 55 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	40	.98	3,600	2,618
Other pumps and power units	40	1.03	1,174	854
Trailers	20	------	41	15
Pipes	44	------	1,275	1,020
Other equipment	42	------	152	116
Land forming	22	------	2,933	1,173
Conveyance structures	29	------	548	289
Land lost	29	5.97 ac.	1,190	629
Total	----	------	--------	6,714
Total per acre irrigated	----	------	--------	50
Total per acre once-over-equivalent	----	------	--------	30

[1] Average acreage irrigated 134; acres once-over-equivalent 221.

Appendix Table 5. Investment per farm for irrigation equipment, conveyance structures, and land forming, 89 farms having wells only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 89 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	89	1.31	5,199	5,199
Other pumps and power units	66	1.61	2,151	1,595
Trailers	41	-----	93	43
Pipes	80	------	3,593	3,230
Other equipment	83	------	687	641
Land forming	37	------	2,961	1,231
Conveyance structures	47	------	672	355
Land lost	41	7.12 ac.	1,424	656
Total	----	------	--------	12,950
Total per acre irrigated	----	------	--------	60
Total per acre once-over-equivalent	----	------	--------	29

[1] Average acreage irrigated 216; acres once-over-equivalent 442.

Appendix Table 6. Investment per farm for irrigation equipment, conveyance structures, and land forming, 50 farms having surface sources of water only, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment: Average per farm reporting	Investment: Average for 50 farms
	Number	Number	Dollars	Dollars
Pumps and power units	50	1.64	2,358	2,358
Trailers	43	------	66	57
Pipes	49	------	3,586	3,514
Other equipment	49	-----	747	732
Land forming	13	------	1,273	331
Conveyance structures	15	------	310	93
Land lost	15	1.75 ac.	350	105
Total	----	------	--------	7,190
Total per acre irrigated	----	-----	--------	49
Total per acre once-over-equivalent	----	-----	------	27

[1] Average acreage irrigated 148; acres once-over-equivalent 269.

Appendix Table 7. Investment per farm for irrigation equipment, conveyance structures, and land forming, 6 farms having wells and surface sources of water, Delta Area, Mississippi, 1956.[1]

Item	Farms reporting	Allocated per farm reporting	Investment	
			Average per farm reporting	Average for 6 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	6	1.33	6,631	6,631
Other pumps and power units	6	3.67	5,047	5,047
Trailers	5	------	128	107
Pipes	6	------	7,127	7,127
Other equipment	6	----	951	951
Land forming	5	----	2,025	1,688
Conveyance structures	2	------	1,218	406
Land lost	5	8.77 ac.	1,754	1,462
Total	----	------	--------	23,419
Totl per acre irrgated	----	------	--------	51
Total per acre once-over-equivalent	----	------	--------	29

[1] Average acreage irrigated 455; acres once-over-equivalent 801.

Appendix Table 8. Investment per farm for irrigation equipment, conveyancee structures, and land forming, 145 farms, Delta Area, Mississippi, 1956.[1]

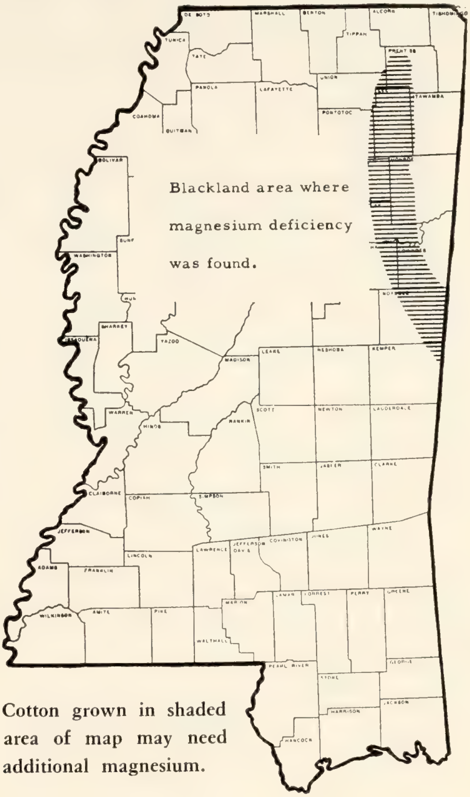
Item	Farms reporting	Allocated per farm reporting	Investment	
			Average per farm reporting	Average for 145 farms
	Number	Number	Dollars	Dollars
Wells, pumps, and power units	95	1.31	5,289	3,465
Other pumps and power units	122	1.72	2,378	2,001
Trailers	89	------	82	51
Pipes	135	------	3,747	3,489
Other equipment	138	------	720	685
Land forming	55	------	2,476	939
Conveyance structures	64	------	605	267
Land lost	61	5.93 ac.	1,187	499
Total	----	------	--------	11,396
Total per acre irrigated	----	------	--------	56
Total per acre once-over-equivalent	----	------	--------	29

[1] Average acreage irrigated 202; acres once-over-equivalent 397.

BULLETIN 560 JUNE 1958

Magnesium Status of Blackland Soils

Of Northeast Mississippi For Cotton Production


Blackland area where magnesium deficiency was found.
DE SOTO
MARSHALL
BENTON
ALCORN
TISHOMINGO
TUNICA
TIPPAH
PRENTISS
TATE
UNION
PANOLA
LAFAYETTE
ITAWAMBA
PONTOTOC
COAHOMA
QUITMAN
BOLIVAR
WASHINGTON
SHARKEY
ISSAQUENA
YAZOO
MADISON
LEAKE
NESHOBA
KEMPER
WARREN
HINDS
RANKIN
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
LINCOLN
LAWRENCE
JEFFERSON DAVIS
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
LAMAR
FORREST
PERRY
GREENE
WILKINSON
AMITE
PIKE
MARION
WALTHALL
PEARL RIVER
STONE
GEORGE
HARRISON
JACKSON
HANCOCK

Cotton grown in shaded area of map may need additional magnesium.

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SUMMARY

In view of these results, farmers in the Blackland area should consider the use of magnesium as a fertilizer for cotton. On soils having a pH above 6.0 Sul Po Mag or some other water-soluble source of magnesium applied annually at the rate of 40 to 60 pounds of MgO per acre was found to be adequate in most cases. Sul Po Mag may be more conveniently applied when incorporated in mixed fertilizers to provide both K_2O and MgO.

On soils having a pH of 6.0 or below dolomitic lime should be an effective source of magnesium for cotton. The rate of application should be one to two tons per acre which can be determined by soil test. Such an application probably will maintain an adequate supply of magnesium for cotton for 10 to 20 years.

At present the State Soil Testing Laboratory, State College, Mississippi, is not in position to test soils for their magnesium status, but on the basis of a soil test for pH, advice can be given as to whether Sul Po Mag or dolomitic lime should be used as a source of magnesium for cotton.

On the basis of several field experiments and the chemical analysis of over 300 samples of cotton leaves taken from farm fields in the various soil areas of the State, magnesium deficiency in cotton was indicated only in the Blackland area of Northeast Mississippi.

MAGNESIUM STATUS OF BLACKLAND SOILS OF NORTHEAST MISSISSIPPI FOR COTTON PRODUCTION

By J. D. LANCASTER[1]

Introduction

Magnesum is essential for normal growth and reproduction of plants. Among other things it is a constitutent of chlorophyll, the substance which imparts green color to plants.

Visual symptoms of magnesium deficiency vary among plants. In corn, it is expressed by yellowish-green, light-yellow, or even white streaks between the parallel veins which may extend the entire length of the leaves. The symptoms are usually more severe on the lower leaves. In cotton the characteristic symptom is a purplish-red leaf with green veins. As with corn the lower (more mature) leaves are affected first and usually shed prematurely. The purplish-red color may appear first on the under side of the leaves. These symptoms are difficult to distinguish from color development due to aging or maturity late in the season, however, the latter is more likely to be orange red rather than purplish red. Magnesium deficiency symptoms are difficult to distinguish from leaf coloration that may develop as a result of an infestation of spider mites. A good response of cotton to fertilization with magnesium may be obtained before acute symptoms of the deficiency are evident.

Available magnesium in soils exists largely in exchangeable form, and it may be removed by treating the soil with water containing table salt in solution, or some other salt solution. When the supply of exchangeable magnesium in soils is reduced sufficiently by crop removal and leaching, magnesium must be added for most efficient and profitable crop production. On acid soils, an adequate supply of exchangeable magnesium may be maintained through the periodic application of limestone that contains a substantial amount of magnesium, such as dolomitic lime. Unfortunately, there are no natural deposits of dolomitic lime in Mississippi.

The need of crops for additional magnesium may also be satisfied by annual applications of water-soluble salts containing magnesium such as $K_2SO_4.2MgSO_4$ (Sul Po Mag) $MgSO_4.\ 7H_20$ (Epsom salt and $MgSO_4.H_2O$ (Kieserite). At present, Sul Po Mag is the only water soluble source of magnesium available commercially in Mississippi at a price that would justify its use as a fertilizer for crops.

Response of Cotton to Magnesium

Field experiments were initiated by the Mississippi Agricultural Experiment Station in 1949 to measure the response of cotton to magnesium and by 1951 trials had been conducted at the Coastal Plain Branch Station (Newton), the Brown Loam Branch Station (Raymond), the Mississippi Experiment Station (State College), and the Black Belt Branch Station (Brooksville). In these trials response of cotton to magnesium was obtained only at the Black Belt Station. Response on the heavy clay soils of the Blackland area was somewhat of a surprise since there were no previous reports (known to the author) of magnesium deficiency on heavy clay soils.

Between 1949 and 1951, Sul Po Mag, Epsom salt, and dolomitic lime were tested at the Black Belt Station on Houston clay (pH 7.1) as sources of magnesium for cotton, and a good response was obtained to all three sources; annual applications of dolomitic lime (applied broadcast over the sides and bottom of the water-furrow at the rate of 450 pounds per acre before the land was re-bedded for planting) were almost as effective as the other sources of magnesium. This also was not expected. In view of these results the work in the Blackland area was expanded after 1951 (1) to determine the extent of magnesium deficiency in cotton on soils of this area, (2) to determine the relative effectiveness of Sul Po Mag, Epsom salt, and dolomitic lime in correcting magnesium deficiency in cotton at other locations, (3) to determine how much magnesium from the different sources should be applied to correct the deficiency in cotton, (4) to study soil factors and fertilizer properties affecting uptake of magnesium by cotton, and, finally (5) to develop techniques for diagnosing magnesium deficiency in cotton.

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[1] Contributions were made to this study by Dr. U. S. Jones, formerly Associate Agronomist in Department of Agronomy, and Messrs. Fred Jones, B. C. Wright, and Ambika Singh, formerly Graduate Assistant in Agronomy. Appreciation is extended to International Mineral & Chemical Corp. for financial assistance in support of this study.

In the field experiments referred to before and in those carried out subsequently, the treatments were arranged in either Latin Square or randomized complete block designs with five to six replications. All plots received uniform and adequate amounts of nitrogen (N) and phosphate (P_2O_5), the sources being ammonium nitrate and 20% superphosphate, respectively. Plots on which treatments were placed to measure the relative effectiveness of sources of magnesium (MgO) received uniform applications of potash (K_2O). With Epsom salt and dolomitic lime as sources of magnesium, muriate of potash (KCl) was the source of potassium, but Sul Po Mag served both as a source of magnesium and potash.

With the exception of dolomitic lime, fertilizers were applied either in the water-furrow and the land re-bedded for planting or in a deep furrow in the side of a fall-prepared seedbed. Annual applications of dolomitic lime were broadcast over the sides and bottom of the water-furrow and the land re-bedded for planting, except that in 1955 at the Davis, the Stevens and the Wilkins farms it was banded in a deep furrow opened in the side of a fall-prepared seedbed. With single, large applications, the dolomitic lime was broadcast over the entire plot and subsequently worked into the soil during seedbed preparation and by cultivation and land preparation afterwards. Appropriate amounts of ammonium nitrate, superphosphate, and muriate of potash were mixed together before being applied to the plots but Epsom salt and Sul Po Mag were not mixed with other materials in most cases.

Sul Po Mag, as marketed, contains approximately 21.5% K_2O and 18.5% MgO. Epsom salt contains approximately 16.6% MgO. The dolomitic lime used in these experiments was obtained from Dolcito Quarry Company, Birmingham, Alabama, and contained approximately 20% MgO. The average physical (screen) analysis was as follows:

Size Mesh Screen	Approximate Percent Passing
4	100
8	75-100
10	65-90
20	40-60
40	20-40
60	15-30
100	10-20
200	some

From 1951-1957, seven field experiments were conducted on dark-colored soils of the Blackland area of Northeast Mississippi. A summary of the results is given in Tables 1 and 2. As will be noted (Table 1) good to excellent response to magnesium was obtained at four locations, probable response at one location (Wilkins farm), and no response at two locations. A significant response to magnesium was obtained on the Wilkins farm in 1955 but not in 1956. Although the data as summarized (Table 1) do not allow a direct comparison of the relative effectiveness of Sul Po Mag and Epsom salt as sources of magnesium for cotton, they nevertheless, depict what was found: There was no measurable difference between Sul Po Mag and Epsom salts as sources of magnesium so long as the rate of application of potassium was the same with each source.

With regard to dolomitic lime as a source of magnesium, it may be seen in Table 2 that some response to dolomitic

Table 1. Response of cotton to Epsom Salt and Sul Po Mag in the Blackland area of Northeast Mississippi.

Location	Soil type and pH	Duration	Source and rate (lbs./A) of MgO and pounds of seed cotton per acre		
			None	Epsom Salts	Sul Po Mag
			0	33 to 100	33 to 100
Black Belt Station	(A) Houston Clay — 7.1	1951-1957[1]	1452	1701	1652
Black Belt Station	(B) Houston Clay — 7.2	1955-1957	1902	2097	2113
Davis Farm	Houston Clay — 7.1	1955-1957	1801	2281	2275
Stevens Farm	Houston Clay — 6.9	1955-1957	2337	2499	2520
Wilkins Farm	Hunt Clay — 6.3	1955-1956	1600	1650	1657
DeMoville Farm	Brooksville Clay — 5.4	1955	1780	1780	1718
Johnson Farm	Brooksville Clay — 5.4	1954	1212	------	1222

[1] 1953 omitted because Sul Po Mag was not included as a treatment.

Table 2. Yield of seed cotton in the Blackland area of Northeast Mississippi as affected by the application of dolomitic lime.

Location, soil type and pH	Year or years in test	Pounds of dolomitic lime applied		Method of application of dolomitic lime and pounds of seed cotton per acre			
		Annually	In one application	No lime	Banded with fertilizer	Broadcast over sides and bottom of water furrow	Broadcast and worked into soil
Black Belt Station							
(A) Houston Clay—7.1	1951-57	900[2]		1499	--------	1713	--------
(B) Houston Clay—7.2	1956-57		2000[1]	2065	--------	--------	2129
	1956-57		4000[1]	2065	--------	--------	2110
Davis Farm							
Houston Clay—7.1	1955	450		2396	2390	--------	--------
	1956-57		2000[1]	1503	--------	--------	1690
Stevens Farm							
Houston Clay—6.9	1955	450		3150	3170	--------	--------
	1956-57		2000[1]	1931	--------	--------	2000
Wilkins Farm							
Hunt Clay—6.3	1955	450		2080	2060	--------	--------
	1956		2000[1]	1120	--------	--------	1086

[1] Dolomitic lime applied first year of indicated period.

[2] In 1951 and 1952, 450 pounds of dolomitic lime was applied; none was applied in 1957. A total of 4000 lbs. per acre was applied from 1951-1956.

lime was obtained at four of the five locations where it was tested, but it compared favorably with Sul Po Mag at only one location (Location (A) Houston Clay, the increase in yield being 14% for both Sul Po Mag and dolomitic lime.

The fact that dolomitic lime was not consistently effective as a source of magnesium in these tests does not mean that it cannot be used as a source of magnesium on some soils of this area. The pH of the soils in this area has been found to vary from as low as 4.5 to above 8.0. The pH of the soil at each location where dolomitic lime was tested was near 7.0 with the exception of the Wilkins farm where it was 6.3. Dolomitic lime, no doubt, would be a satisfactory source of magnesum on soils having a pH of 6.0 or less. As is shown in Table 3, a relatively high percentage of the soils having a pH of 6.0 or less are deficient in magnesium. No less than one and probably two or more tons of dolomitic lime is required when applied in a single application and worked into the soil to correct magnesium deficiency in these soils.

The correct rate can be determined only by appropriate soil tests. When applied at the proper rate, dolomitic lime should provide an adequate supply of magnesium for as long as 10 to 20 years on these soils.

In 1955 at the Davis, Stevens, and Wilkins farms where the dolomitic lime was banded in a deep furrow opened in the side of a fall-prepared seedbed, no response was obtained, and similar results would be expected from dolomitic lime added as a filler to fertilizers that are applied to soils similar to these (pH 6.0 and above).

Rate of Sul Po Mag to Apply

The effect of rates of magnesium (MgO) on the yield and magnesium content of cotton leaves taken in July and/or August is reported in Tables 4 and 5.

Table 3. Incidence of magnesium deficiency on dark colored soils of Blackland area as related to degree of soil acidity (pH).

Number of soils	Soil pH of 6.0 or below	Soil pH above 6.0
Examined	26	50
Deficient in MgO[1]	15	37
Percentage deficient	58	74

[1]Deficiency indicated when the percentage saturation of the cation exchange—complex of the soil with magnesium is 6.4 or less.

Table 4. Yield of seed cotton and magnesium content of cotton leaves as affected by sources and rates of magnesium on (A) Houston Clay at the Black Belt Branch Station.

Treatment[1]			Yield of seed cotton and magnesium content of the cotton leaves[3]			
Pounds of MgO per acre		Source of Magnesium	1953		1955	
1953	1955		Lbs./A	Meq/100 gms.	Lbs./A	Meq/100 gms.
0	0		1732	15.9	2252	13.6
Trace	......	Calcitic Lime[1]	1652	14.9	......	......
33	33	Epsom Salt	1923	18.5	2605	20.8
......	33	Sul Po Mag	......	......	2459	18.5
100	100	Epsom Salt	1940	32.7	2698	29.6
100	100	Dolomitic Lime[2]	1854	18.1	2403	18.4
200	200	Dolomitic Lime[2]	1900	20.5	2472	19.4
	LSD 0.05		202	......	185	......

[1]Obtained from State Lime Plant, Cedar Bluff, Mississippi.

[2]Dolomitic lime was broadcast over the sides and bottom of the water furrow on bedded land; other fertilizers were drilled in the water furrow and the land was re-bedded.

[3]Leaf samples taken from field experiments and farm fields were collected by taking the fifth or sixth axillary leaf from the bud whorl (includes in this case the top-most inch to one and one-half inches of the bottom plant) or top was selected.

Table 5. Contents of magnesium and potassium in cotton leaves as affected by applications of Epsom Salt and muriate of potash alone and in combiantion on Brooksville Clay Loam, 1955.

Treatment		Amounts of magnesium (MgO) and potassium (K_2O) in cotton leaves expressed in meq/100 gms[1]	
MgO	K_2O	MgO	K_2O
0	0	26.9	21.3
36	0	34.6	18.0
72	0	39.6	15.4
108	0	43.6	14.9
0	42	26.4	28.5
0	126	22.5	43.6
36[2]	42[2]	32.6	26.3
72[2]	84[2]	34.4	34.4
108[2]	126[2]	34.6	40.3

[1] Average of July and August samplings.

[2] These treatments supplied MgO and K_2O in the same proportion as they occur in Sul Po Mag.

Data is also presented for one rate of Sul Po Mag, Table 4. As will be noted in Table 4, both the yield of seed cotton and the magnesium content of the cotton leaves increased as the rate of MgO as Epsom salt was increased to 100 pounds an acre, however, there was very little increase in yield above 33 pounds of MgO an acre. In other years the increase for 100 pounds of MgO over 33 was somewhat greater than for the years reported.

From these results it may be concluded that more than 33 but not as much as 100 pounds of MgO as Epsom salt, or Sul Po Mag should be applied annually. Further information as to the rate of Sul Po Mag is presented in Table 5. It illustrates the effect of the magnesium to potassium ratio in the fertilizer on the uptake of these elements by the cotton plant. A corresponding increase in the magnesium content of the cotton leaves occurred with each increase in the rate of application of MgO where no potassium was applied, but where MgO and K_2O were increased together in the same ratio as they occur in Sul Po Mag application of more than 72 pounds of MgO did not increase the magnesium content of the cotton leaves. Thus it would appear that the rate of application of Sul Po Mag should not exceed 390 pounds per acre (72 pounds of MgO) irrespective of the degree of magnesium deficiency unless additional potassium is needed.

When all factors are considered, it appears that an annual application of 40 to 60 pounds of MgO as Sul Po Mag, or Epsom salt, was adequate at the Black Belt Station. This also appeared to be the case at the other locations where response to magnesium was obtained.

Although Epsom salt was employed as a source of magnesium, it is too expensive to be used as a fertilizer, also it is not available in fertilizer grade and, therefore, is not recommended.

Perhaps the most convenient way to apply 40 to 60 pounds of MgO as Sul Po Mag to cotton would be to use a mixed fertilzer of 1:1, P_2O_5 to K_2O ratio formulated with Sul Po Mag as the source of both K_2O and MgO. Such a fertilizer applied at a rate to give 48 pounds (the recommended rate in the absence of a soil test) each of K_2O and P_2O_5 per acre would supply about 41 pounds of MgO per acre. Sul Po Mag may be used without being mixed with the other fertilizer ingredients before application; if so it should be applied prior to or at planting. Enough should be applied to meet either the potassium or magnesium requirement whichever is greater, and the fertilizer used to supply nitrogen (N) and phosphate (P_2O_5) need not contain potassium (K_2O). Based on 1957 prices, the cost of MgO was about $1.10 per unit (20 lbs.) when the total cost of Sul Po Mag was prorated between K_2O and MgO.

Extent of Magnesium Deficiency

As was pointed out before, both the yield of seed cotton and the magnesium content of the cotton leaves increased progressively as the rate of MgO was increased (Table 4). At the Black Belt Station careful study indicated little, if any, additional response to magnesium would be obtained beyond that required to give a leaf content of magnesium of about 25 meg. per 100 grams. Also, leaf samples taken from plots receiving no magnesium at other locations showing response to magnesium contained less than 20 meg. of magnesium per 100 grams of sample, and at locations showing no response to magnesium the magnesium content of the leaves was 25 meg/100 grams or above.

Since the intensity of magnesium deficiency was found to be associated with the magnesium content of the leaves, a basis was provided for diagnosing the magnesium status of soils on which cotton is grown in this area. Accordingly, in the summer (July) of 1955 samples of cotton leaves were collected from farm fields (along with soil samples) and analyzed for their magnesium content.

A classification of the results of the leaf analyses according to degree of deficiency, or expected response (Table 6) indicated excellent response to magnesium in 29% of the fields, good response in 24%, probable response in 16%, and no response in 31%.

Soil Factors Affecting the Uptake of Magnesium by Cotton

Appropriate chemical analysis of soil samples collected in 1953 and 1955 was accomplished. From a statistical evaluation of the relationship between soil factors (Mg/K ratio, Mg/Ca ratio, and percentage saturation of the cation exchange-complex with magnesium) and the uptake of magnesium by cotton grown on these soils, it was found that an excellent correlation (relationship) existed between percentage saturation of the soil exchange-complex with magnesium and the magnesium content of the leaves of cotton growing on these soils. Therefore, either chemical analysis of selected leaf samples or the soil may be employed to predict the need of cotton for magnesium in this area. Variations of the Mg/K ratio and the Mg/Ca ratio that occurred in these soils did not have a significant effect on the uptake of magnesium by cotton. However, it has been shown by others and as a part of this study it was found in greenhouse experiments with Sudangrass that the Mg/K ratio does affect the uptake of magnesium by plants. Thus, under some conditions the Mg/K ratio should be taken into account when assessing the magnesium status of soils for crop production. With an adverse Mg/K ratio caused by a high level of exchangeable K in the soil, Sul Po Mag probably would not be effective as a source of magnesium for plants since, on the basis of chemical equivalance, it contains one half as much potassium as magnesium, and additional potassium would serve only to aggravate the condition.

The relationship between the magnesium status of soils of this area as determined by chemical analysis and the magnesium content of the leaves of cotton grown on these soils, as well as the extent of magnesium deficiency, is shown in Table 6. On the basis of chemical analysis excellent response of cotton to magnesium was indicated on 24% of the soil, good response on 26%, probable response on 18%, and no response on 32%.

Table 6. Extent of magnesium deficiency in soils of Blackland Area as indicated by level of exchangeable magnesium when expressed as percentage saturation of the cation exchange-complex of the soil.

Percentage saturation of cation exchange—complex of the soil with magnesium	Probable magnesium content of cotton leaves—mg/100 gms. of leaves	Percentage of soils examined having indicated saturation with magnesium	Expected response of cotton to magnesium
Below 3.0	Below 10.0	24	Excellent
3.0-4.6	10.0-17.5	26	Good
4.7-6.4	17.6-25.0	18	Probable
Above 6.4	Above 25.0	32	None

M66b

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The Effect of Various Levels of Solids Not Fat on the Flavor Acceptability of Fluid Milk

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The Effect of Various Levels of Solids Not Fat on the Flavor Acceptability of Fluid Milk

By E. W. CUSTER, F. H. HERZER and J. T. CARDWELL

Processors of market milk have long been concerned over the flat watery flavor of fluid milk in the spring. Sales records show that consumption of milk drops sharply during this season and analyses show a low percent of solids not fat. Herman (3) stated that during certain months, approximately 50 percent of the samples of milk analysed from the herd at the University of Missouri were substandard in solids not fat for some city codes. Roadhouse and Henderson (7) concluded that taste scores of milk followed the trend of the lactose content, the taste score lowering and rising as lactose decreased and increased.

Roadhouse and Koestler (6) stated that the chloride-lactose relation was one of the most important factors affecting milk taste and that the primary taste of skim milk was practically equal to that of the whole milk from which it was separated. By the application of dialysis it was possible to separate milk into two parts (dialyzate and residue) with extreme difference in taste. It was found that nearly all of the milk components producing the primary taste were present in the dialyzate while the components remaining in the residue could be designated as free from taste. By dialysis it was further demonstrated that fat and protein substances as well as certain difficulty dialyzable salts, all of which go to make up a large percentage of the milk content, play only a subordinate part in the primary taste of milk.

MacCurdy and Trout (4) in flavor tests to determine the effect of vat and flash pasteurization generally placed "flat" flavored milk in third place of importance after "cooked" and "feed." Flat flavor in milk usually indicates low solids or added water. Davis et al. (1) state that the percentage of samples falling below the minimum requirements of Arizona for solids not fat were 47.5% for Holstein, 2.2% for Guernsey, and 2.5% for Jersey. Also Davis et al. (2) state that solids not fat content of milk from Holstein cows studied averaged below 8.5% during the spring and summer months.

In the past much emphasis has been placed on the butterfat and most milk plants standardize to a predetermined fat content in various products. Some work has been done on the addition of solids not fat to fortify fluid milk but little work has been done on double standardization for the fluid milk market. The addition of nonfat milk solids will increase the food value of the product by supplying additional increments of essential proteins, lactose, and minerals. Since the consuming public is becoming more protein conscious, these additional solids not fat should meet with favor. If the flavor can also be improved the product should receive greater consumer acceptance, thereby increasing consumption of milk and nonfat milk solids now in surplus.

Various levels of fat and solids not fat in fluid milk were prepared and examined for flavor acceptability by a trained panel. Nelson and Trout (5) concluded that experienced judges were capable of passing upon consumer acceptance. Since definite quality standards have been established for dairy products acceptable to the consuming public a few experienced judges can replace large inexperienced panels and still provide reliable results. In order to speed up the elimination of the least acceptable combinations, two trained judges were used.

The study was divided into four main parts:

Part I. The Effect of Adding 1% and 2% Nonfat Dry Milk Powder to 4% Milk.

Part II. The Effect of Various Levels

of Solids Not Fat on the Flavor Acceptability of Milk at Various Butterfat Percentages.

Part III. A Comparison of the Flavor Acceptability of Double Standardized Milk Pasteurized by the Vat and H.T.S.T. Methods.

Part IV. A Comparison of Certain Combinations of Double Standardized Fluid Milk.

Experimental Procedure and Results

Milk used in this study was mixed milk from the Mississippi State University herd consisting of Ayrshire, Brown Swiss, Guernsey, Holstein, and Jersey cows and was handled through a glass pipeline milker. The milk was cooled over a surface cooler to 40° F. and flowed by gravity into a 500 gallon stainless steel trailer tank. It was delivered to the University dairy products plant daily. Grade "A" low heat nonfat milk solids of clean flavor and high solubility were used to fortify the milk to various percents of solids not fat.

Since most milk marketed as fluid milk in Mississippi contains around 4% butterfat, this level was selected for the initial study. Pasteurized homogenized milk containing 4% butterfat was compared with the same milk fortified with one and two percent solids not fat.

Part I. The Effect of Adding 1% and 2% Nonfat Dry Milk Powder to 4% Milk: Thirty gallons of mixed milk were standardized to 4% butterfat and divided into three lots of ten gallons each. One lot was used as a control; the second lot was fortified with 1.0% solids not fat, and the third lot was fortified with 2.0% solids not fat. The nonfat dry milk solids were added to each lot by mixing the powder with a small amount of the same milk in a Waring blender, then adding to the remainder of the lot. All samples were tested for fat by the Babcock method and for total solids by the Mojonnier method.

Each lot was pasteurized in a stainless steel 50-gallon pasteurizer at 145° F. for 30 minutes, homogenized at 2200 p.s.i., and cooled over a surface cooler to 40° F. The samples were coded and judged by two trained dairy products judges. These judges placed the samples in order of acceptability. Seventy-five comparisons were made.

The results in table 1 indicate that milk fortified with 1.0% solids not fat was selected as most acceptable 38 times and least acceptable 8 times. The 2.0% sample was placed first 14 times and last 46 times. In general the 2.0% level was criticized as being too sweet. This phase of the study indicated that the addition of one percent solids not fat improved the flavor acceptability of 4% fluid milk.

Table 1. Effect of varying the level of solids not fat in 4.0% milk.

Percent S.N.F.*	Percent S.N.F. added	Placings in 75 comparisons**		
		1st	2nd	3rd
9.07	0	23	31	21
10.06	1.0	38	29	8
11.09	2.0	14	15	46

*Average of 5 replications.
**Samples examined twice daily for six days.

Part II. The Effect of Various Levels of Solids Not Fat on the Flavor Acceptability of Milk at Various Butterfat Percentages: Fat levels of 3.0%, 3.5%, and 4.0% were used while the solids not fat content was varied from 9.0% through 11.0% in increments of 0.5%. A control sample in which only the butterfat was standardized to 4.0% was used in each series of flavor comparisons. The solids not fat content of the control sample varied from 8.89% to 9.02%. Milk testing less than 3.0% was not studied since in most sections of this country milk below that percent is classified as skim milk.

Three replications were made at each fat level wherein the solids not fat varied from 9.0% to 11.0%. The usual system of processing and scoring was followed and the samples were placed in order of desirability.

The results of 36 trials at the 3.0% fat level are shown in table 2-A. Milk containing 3.0% butterfat and fortified to 10.0% solids not fat content placed first in flavor acceptabiilty 19 times and in no comparison was selected least acceptable. Three percent milk standardized to 9.0% solids not fat ranked last in 22 of the 36 trials and in no trial was given a first place. The control sample testing 4% fat was not placed first in any trial and was considered least acceptable 9 times.

Table 2-B shows the effect of varying the solids not fat at the 3.5% butterfat level. At this fat percent, milk standardized to 9.5% serum solids was selected most acceptable 14 times while the same milk with 10% solids not fat was judged best 10 times in 36 comparisons. The samples containing 9.0% and 11.0% solids not fat and the control samples were each found to be least acceptable 12 times.

Table 2-C records the effect of varying the solids not fat at the 4.0% butterfat level. Fluid milk containing 4% butterfat and standardized to 9.5% solids not fat was most acceptable to the judges 19 times in 36 comparisons. Milk standardized to 9.0% solids not fat was selected least desirable 10 times while the same milk containing 11.0% solids not fat was judged last in 13 of the 36 trials.

The results of this study showed that:

(1) Milk testing 3.0% fat was most acceptable when double standardized to 10% solids not fat.

(2) Milk testing 3.5% fat was most acceptable when double standardized to 9.5% solids not fat; and

(3) Milk testing 4.0% fat was most acceptable when double standardized to 9.5% solids not fat.

Table 2-A. Effect of varying the solids not fat level on the flavor acceptability of 3.0% butterfat fluid milk.

Percent S.N.F.*	Placings in 36 trials					
	1st	2nd	3rd	4th	5th	6th
9.01	0	0	1	2	11	22
9.49	4	7	9	9	5	2
10.02	19	9	4	3	1	0
10.51	5	11	12	5	3	0
10.98	8	5	7	10	3	3
Control 9.01**	0	4	3	7	13	9

*Average of 3 replications.

**4.0% butterfat and an average of 9.01% solids not fat.

Table 2-B. Effect of varying the solids not fat level on the flavor acceptability of 3.5% butterfat fluid milk.

Percent S.N.F.*	Placings in 36 trials					
	1st	2nd	3rd	4th	5th	6th
8.97	1	2	6	9	6	12
9.46	14	10	6	3	3	0
9.97	10	13	5	6	2	0
10.47	6	6	11	4	8	1
10.99	2	4	2	7	9	12
Control**	3	2	5	7	7	12

*Average of 3 replications.

**Contained 4.0% butterfat and an average of 9 01% solids not fat.

Table 2-C. Effect of varying the solids not fat level on the flavor acceptability of 4.0% butterfat fluid milk.

Percent S.N.F.*	Placings in 36 trials					
	1st	2nd	3rd	4th	5th	6th
9.04	3	3	8	6	6	10
9.52	19	8	1	3	5	0
10.01	6	11	8	4	5	2
10.51	4	6	5	8	8	5
11.00	1	1	5	7	9	13
Control**	3	7	9	8	3	6

*Average of 3 replications.

**Contained 4.0% butterfat and an average of 8.99% solids not fat.

Part III. A Comparison of the Flavor Acceptability of Double Standardized Milk Pasteurized by the Vat and H.T.S.T. Methods: Eighty gallons of milk from the State University herd were adjusted to 3.0%, 3.5%, and 4.0% butterfat and 9.0% solids not fat. The milk was then divided into four lots. Lots 1 and 2 were fortified to 9.5% or 10.0% solids not fat depending upon the fat content while lots 3 and 4 with 9.0% solids not fat were used as the controls. After double standardization lots 1 and 3 were pasteurized by the vat method at 145° F. for 30 minutes, homogenized and cooled. Lots 2 and 4 were pasteurized by the H.T.S.T. method at 165° F. for 16 seconds, homogenized and cooled.

The results of 24 comparisons are recorded in tables 3-A, 3-B, and 3-C. Table 3-A shows the comparison at the 3.0% butterfat level. The sample which was double standardized to 3.0% butterfat and 10% solids not fat and pasteurized by the H.T.S.T. method was selected most desirable 17 times. In no comparison was it least desirable. The same milk pasteurized by the vat method was selected most desirable only 7 times and least desirable zero times.

Table 3-B shows that the milk double standardized to 3.5% butterfat and 9.5% solids not fat and pasteurized by the H.T.S.T. method was classed as most acceptable 15 times and least acceptable zero times. The same milk pasteurized by the vat method was selected most desirable 6 times and least desirable 3 times.

Table 3-C on the 4.0% butterfat level shows that milk double standardized to 4.0% fat, 9.5% solids not fat, and pasteurized by the H.T.S.T. method was chosen as being most desirable 13 times and least desirable 2 times. The same milk pasteurized by the vat method was selected most desirable 7 times and least desirable zero times.

At each of these levels milk double standardized to the 9.0% solids not fat level and pasteurized by the H.T.S.T. method was least acceptable and was placed last 43 times in the 72 comparisons. Vat pasteurized milk double standardized to the 9.0% solids not fat level was scored least desirable in 24 of the 72 comparisons.

The milk that was pasteurized by the H.T.S.T. method, to which the largest increments of solids not fat were added was judged most desirable at all fat levels. Therefore the data presented in this study indicate that greater benefits were derived from the use of additional solids not fat when milk was H.T.S.T. pasteurized than when the

Table 3-A. A comparison of flavor acceptability of milk pasteurized by the H.T.S.T. and vat methods having 3.0% butterfat and 9% solids not fat and 3.0% fat and 10% solids not fat.

Pasteurization method employed	Percent B.F.	Percent S.N F.	Placings in 24 comparisons			
			1st	2nd	3rd	4th
H.T.S.T.	3.0	8.98	0	1	7	16
H.T.S.T.	3.0	10.03	17	5	2	0
Vat	3.0	8.98	0	8	8	8
Vat	3.0	10.03	7	10	7	0

Table 3-B. A comparison of flavor acceptability of milk pasteurized by the H.T.S.T. and vat methods having 3.5% butterfat and 9.0% solids not fat and 3.5% fat and 9.5% solids not fat.

Pasteurization method employed	Percent B.F.	Percent S.N F.	Placings in 24 comparisons			
			1st	2nd	3rd	4th
H.T.S.T.	3.5	9.06	3	1	7	13
H.T.S.T.	3.5	9.52	15	9	0	0
Vat	3.5	9.06	0	6	10	8
Vat	3.5	9.52	6	8	7	3

Table 3-C. A comparison of flavor acceptability of milk pasteurized by the H.T.S.T. and vat methods having 4.0% butterfat and 9.0% solids not fat and 4.0% fat and 9.5% solids not fat.

Pasteurization method employed	Percent B.F.	Percent S.N.F.	Placings in 24 comparisons			
			1st	2nd	3rd	4th
H.T.S.T.	4.0	9.07	2	0	8	14
H.T.S.T.	4.0	9.54	13	8	1	2
Vat	4.0	9.07	2	5	9	8
Vat	4.0	9.54	7	11	6	0

same milk was pasteurized by the vat method.

Part IV. A Comparison of Certain Combinations of Double Standardized Fluid Milk: Based on the results obtained from Part II of this study three lots of mixed herd milk were double standardized to the most acceptable butterfat and solids not fat level while one lot was used as a control at 4.0% fat and 9.0% solids not fat. These four lots of milk were pasteurized by the H.T.S.T. method, homogenized, cooled to 40° F., coded and judged for flavor aceptability by the two judges.

Table 4 shows the results of 12 trials. Each sample was placed in order of flavor acceptability from 1st through 4th place. The milk double standardized to 3.0% fat and 10.0% solids not fat was selected most acceptable 10 times. The same level of milk was placed second 12 times and was scored third and fourth only two times out of a possible 24. The same milk double standardized to 4.0% fat and 9.5% solids not fat was placed first and second a total of 16 times while being placed third and fourth a total of 8 times. The control sample which was double standardized to 4.0% fat and 9.0% solids not fat was placed first 2 times while being judged least desirable in 16 of the 24 trials. These results indicate that milk double standardized to 3.0% fat and 10.0% solids not fat and 4.0% fat and 9.5% solids not fat were the most desirable combinations studied. All combinations of double standardized milk were judged to be more acceptable than the control.

Table 4. A comparison of the most acceptable levels of double standardized fluid milk.

Percent B.F.	Percent S.N.F.	Order of flavor acceptability in 24 comparisons			
		1st	2nd	3rd	4th
3.0	9.98	10	12	1	1
3.5	9.51	4	4	12	4
4.0	9.49	8	8	5	3
4.0	9.08	2	0	6	16

Discussion

Market milk from the Mississippi State University dairy herd containing no added solids not fat is less acceptable than milk fortified with nonfat dry milk to prescribed levels. Milk fortified above the 10% solids not fat level is objectionable and usually criticized as being too sweet. The taste panel indicated that a decrease in fat content can be offset by the addition of solids not fat.

The controlled addition of solids not fat in the form of Grade "A" low heat powder of excellent quality did not impart any objectionable cooked or other off flavor. It had no adverse affect on the keeping quality of the milk as far as flavor acceptability was concerned.

The total solids content of fluid milk may be determined by use of a Cenco moisture balance in less time than is required to determine the butterfat by the Babcock method. Double standardization can then be practiced with little additional time involved.

The authors are fully aware that, at present, the addition of solids not fat is prohibited by law unless labeled as such and are in no way suggesting or recommending that dairy plants violate this regulation. This study simply points to the desirability of double standardization to improve the nutritional value, uniformity of flavor and acceptability of market milk.

Summary and Conclusions

Processors of market milk have long been concerned over the flat, watery flavor of fluid milk in the spring. No doubt this is a factor in the drop in milk consumption during this season. Analyses show a lower percent of solids not fat at this time. Since it is known that solids not fat play an important role in the flavor acceptability of market milk this work was initiated to study the effect of varying both the fat and solids not fat content. The study was designed to determine the desirability of double standardization in developing a more uniform product from day to day. By the addition of clean flavored solids not fat the milk studied was improved in flavor acceptability.

As an exploratory investigation to determine the effect of fortifying with solids not fat, milk containing 4% fat was fortified with 0%, 1% and 2% solids not fat. The milk containing the 1% added solids not fat was the most acceptable to the judging panel. The addition of solids not fat above the 1% level was less acceptable and was criticized as being too sweet.

In order to evaluate the effect of fat and to reach the most acceptable level of solids not fat at each fat level, market milk samples containing 3.0%, 3.5%, and 4.0% fat were standardized from 9.0% through 11.0% solids not fat in increments of 0.5%. At the 3.0% fat level, milk containing 10.0% solids not fat was selected as the most acceptable. At the 3.5% level the sample containing 9.5% solids not fat was judged most acceptable, and at the 4.0% level and milk containing 9.5% solids not fat was placed first by the judging panel.

In the first phase of this study milk containing 1.0% added solids not fat was selected over milk containing 0% and milk containing 2% added solids. However, further investigation showed that the 1.0% added solids not fat level was less acceptable as the fat was increased and that at 3.5% and 4.0% fat levels a product containing 9.5% or approximately 0.5% fortified solids not fat was the most acceptable. At each fat level milk fortified to some degree with solids not fat was selected over a control sample containing no added solids not fat.

Since added solids not fat may have a tendency to produce a cooked flavor in milk a comparison was made of the vat method and H.T.S.T. method of pasteurization. Samples of the same market milk double standardized to the most acceptable levels were pasteurized by each method and scored by the judges. The milk pasteurized by the H.T.S.T. method was selected as most acceptable. Powder of clean flavor did not impart any cooked or other objectionable flavor to the finished product.

In order to determine the most acceptable level of double standardized milk, samples at each level were processed by the H.T.S.T. method and submitted to the judging panel. Milk containing 3.0% fat and 10% solids not fat, and 4.0% fat and 9.5% solids not fat were selected as the most acceptable levels. All combinations fortified to 10.0% or less solids not fat were more acceptable than the control sample containing no added solids not fat.

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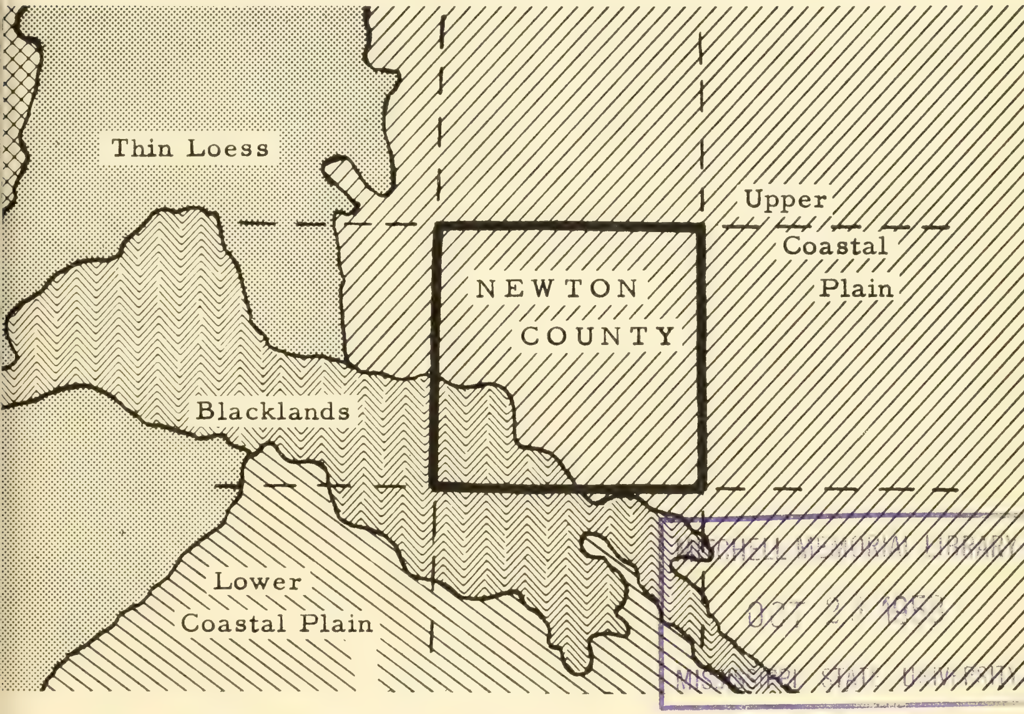
BULLETIN 562 JULY, 1958

Newton County Soils

Major Uses and Management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STATE COLLEGE MISSISSIPPI

Newton County Soils

By

L. C. MURPHREE

SOIL SURVEY PARTY
for
NEWTON COUNTY

L. C. Murphree in charge, C. H. Freeman, H. L. Neal and W. W. Nye, Soil Conservation Service, United States Department of Agriculture, L. C. Standifer, Mississippi Agricultural Experiment Station.

Area inspected by I. L. Martin, Senior Correlator, Soil Conservation Service, United States Department of Agriculture.

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Newton County Soils—Major Uses and Management

Introduction

This bulletin describes Newton County soils in detail. It is intended for use with a special soil map of any farm which may be obtained from the Soil Conservation Service or the County Agent's office in Decatur, Mississippi, the county seat.

In order to prepare this bulletin and the map a county-wide soil survey was made. The Soil Conservation Service and the Mississippi Agricultural Experiment Station, working together, studied almost every acre of land in the county. This was done to classify the soils and to find out which are best suited for crops, pastures and forests.

The soils of Newton County are not so uniform that every spot in an area mapped one particular type of soil will be identical. Due to past management and past land use, all of the same soil types will not produce the same crop yields. It must be understood that the various soil types or mapping units have a range in properties.

Soils must be examined to a depth of 36 inches or more for proper classification. Often two soils have identical surface layers but differ widely in the subsoil and therefore have different land uses. The subsoil regulates such important things as water-holding capacity, depth and extent of root growth, leaching and soil temperature which greatly affects plant growth. A cross-sectional view of a soil, including its surface, subsoil and parent material, is called a soil profile. For the reasons given above the entire soil profile is important.

Symbols and Numbers on Map

The first step in using your soil map is to examine it carefully and become familiar with symbols used to designate certain features found on the land. (See pages 7 and 8)·

Every separate area of soil is identified on the map with a code number. The first number tells the soil type, the letter indicates the percent of slope and the second number the amount of erosion that has taken place. The combination of numbers and letter is called the mapping unit.

For example, 38B2 is analyzed as follows:

38—The soil is well drained Ruston fine sandy loam

B—The soil has a slope of 2 to 5 percent

2—The soil is a moderately eroded phase (25 to 75 percent of the original surface may have been lost by erosion)

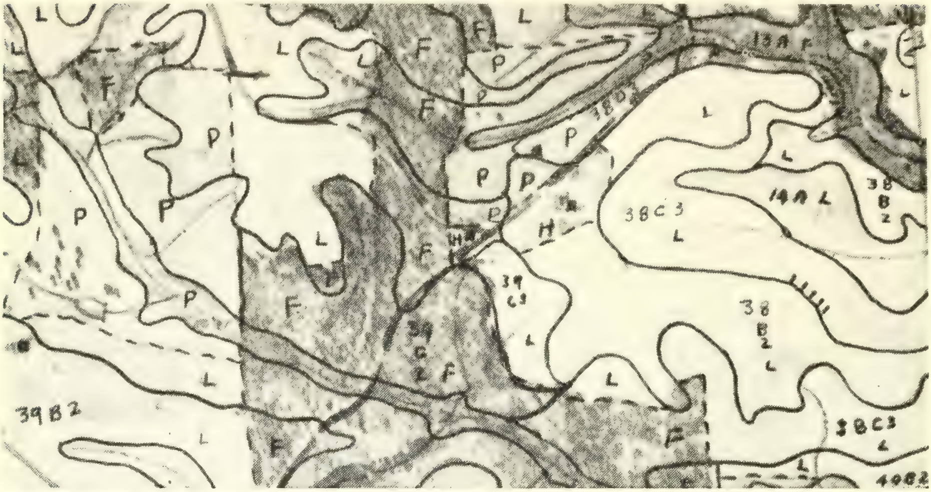
Good Uses for Your Soil Map

Determining Best Land Use—The first step in producing high yields is to select land to which a particular crop is adapted. The soil map will help you do this. Some soils will produce higher yields of a specific crop than other soils. For example Ruston fine sandy loam will produce more cotton than Boswell fine sandy loam. Since cotton is still the chief cash crop the land on the farm best adapted to cotton is planted to it. However, it is important that the remaining soils on the farm be planted to crops adapted to them.

Guide to Drainage—Good drainage is important for most soils of Newton County. The soil map can be a good guide for locating a system of natural drainage. The type and size of ditch should be governed by the size of the watershed area and the soil types comprising it. Surface runoff from sandy soils is much less than from clay soils; therefore, the clay soils require more and larger ditches.

Basis for Field Layout and Row Direction—When practical, field boundaries should be placed on soil boundaries that separate soil types requiring different treatment. Fertilizer application and other management practices suitable for the entire field can be planned.

Row direction should be governed by



This is a soil map of a portion of Newton County. The diagram below explains the symbols appearing on the map.

COMPOSITE SOIL SYMBOL

The following arrangement of units of composite symbol are used:

Soil type number - Slope class - Erosion class

Soil Type (Number assigned to Ruston fine sandy loam)

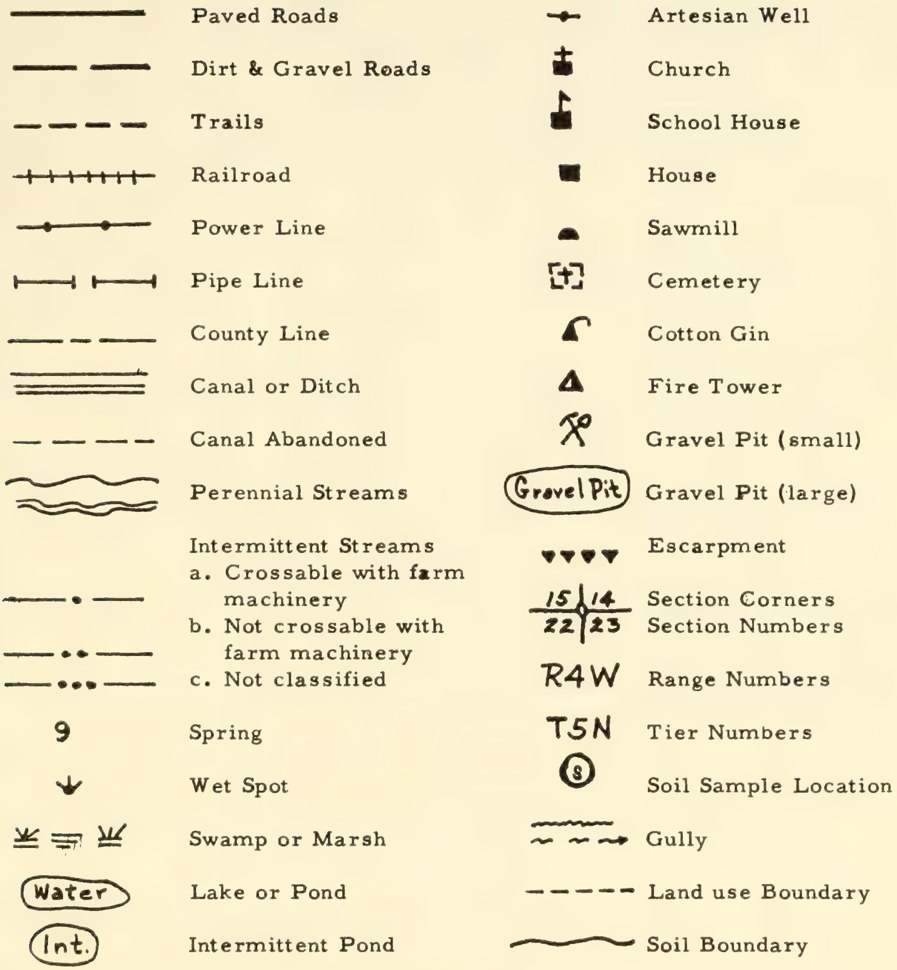
38-B-2

Slope
A. 0 - 2 percent
B. 2 - 5 "
C. 5 - 8 "
D. 8 - 12 "
E. 12 - 17 "
F. 17 & above

Erosion
1. None to slight (less than 25% of original surface has been lost).
2. Moderate (25 to 75% of the original surface has been lost).
3. Severe (more than 75% of the original surface and part or all of the B horizons have been lost from the area).
4. Very severe (all of the A horizon and much of the B horizon is absent, the plow layer consists of a mixture of B and C or D horizons).

Present Land Use
L---Cultivated land
F---Wooded land
X---Idle land
P---Permanent grass land
H---Urban areas, farmsteads, etc.

MAPPING SYMBOLS


Paved Roads
Dirt & Gravel Roads
Trails
Railroad
Power Line
Pipe Line
County Line
Canal or Ditch
Canal Abandoned
Perennial Streams
Intermittent Streams
a. Crossable with farm machinery
b. Not crossable with farm machinery
c. Not classified
9
Spring
Wet Spot
Swamp or Marsh
Water
Lake or Pond
Int.
Intermittent Pond
Artesian Well
Church
School House
House
Sawmill
Cemetery
Cotton Gin
Fire Tower
Gravel Pit (small)
Gravel Pit
Gravel Pit (large)
Escarpment
15 14
22 23
Section Corners
Section Numbers
R4W
Range Numbers
T5N
Tier Numbers
S
Soil Sample Location
Gully
Land use Boundary
Soil Boundary

the soil type, slope, and method of tillage. Soils on level relief require row direction that allows the best possible runoff. On poorly drained soils the row direction should be such that each row will carry the excess water to an outlet. However, this should not be done to the extent that erosion occurs. The moderately-well and well drained soils should have rows running on the contour in order to conserve moisture and prevent erosion.

Land Capability Classes for Newton County

Several different colors may appear on the land-capability maps. There may be as many as six colors. Each color tells you about the land: whether it is suited for cultivation or not, and the general degree of difficulty or risk involved in its safe use without damage. Each color shows one of six classes of land that are called land-capability classes. The table on land use and management shows the class and color found on the map, and also the subclass and soil type and phase found in each class. The classes are distinguished by Roman numerals as well as by the standard colors.

Classes II and III include the land that is suited for regular cultivation, and Class IV the land that can safely be cultivated only once every 4 or 5 years, that is, in a limited way. Classes V, VI, and VII are not suited for cultivation.

Here are descriptions of the six land capability classes:

Class II land is good but it has some limitations. It needs moderately intensive treatment if it is to be cultivated safely. Such treatment, for example, may be contouring and cover cropping to control erosion, or simple water-management operations to conserve rainfall.

Class III is moderately good land and can be used for cultivated crops regularly in a farming system which includes an adapted rotation and by plowing on the contour in sloping fields. It has limitations of such degree that intensive treatment is necessary. The treatment may be terracing or strip-cropping to control erosion, or intensive water management on flat wet areas.

Class IV is fairly good land, but its safe cropping use is very limited by natural features such as slope, erosion, adverse soil characteristics, or adverse climate. As a rule its better use is for pasture or hay, but some of it may be cultivated once every 5 or 6 years with proper safeguards.

Classes V, VI, and VII are not suited for any cultivation but may be used for grazing or forestry, according to adaptability. Class V land has few natural limitations for such uses, and needs only good management. Class VI needs protective measures, usually because of slope or shallow soil. Class VII needs extreme care to overcome or cope with its major limitations, which usually are steep slope, very shallow soil, or other unfavorable features.

Map Tells More Than Land-Capability Classes—Physical features of the land that make its use difficult or risky determine the land capability class. These physical features are of several different kinds. Some land is subject to improvising erosion if it is not protected. Other land is naturally wet, so that drains must be installed or maintained if crops are to be grown. Some land is shallow, or has other special conditions. These three kinds of limitations which are designated by the "e", "w" and "s" make up the three possible subclasses of land within each of the land-capability classes.

Within Class III land, for example, all three of these land-capability subclasses occur. All Class III land is rather severely limited in its use, although it is suited for regular cultivation. Often all three of these subclasses—wet land, sloping land, and land with special soil conditions—are found on a single farm. They are suited for different crops and should be managed in different ways. The land-capability maps show the subclasses. It also shows, by means of mapping symbols, significant variations in the subclasses. Table 1 lists the capability class, subclass and soil type and phase.

Table 1. Classes of land in Newton County.

Land Capability			
Class	**Subclass**	**No.**	**Soil Types and Phases**
I Green on Map	I-1	14	Ochlockonee fine sandy loam
		26	Cahaba fine sandy loam
II Yellow on Map	IIe	38	Ruston fine sandy loam A3, B2, & B3
		26	Cahaba fine sandy loam A3, B2, & B3
		39	Ora fine sandy loam A3, B2, & B3
		40	Savannah fine sandy loam A3, B2, & B3
		23	Prentiss fine sandy loam A3, B2, & B3
		24	Tilden fine sandy loam A3, B2, & B3
		43	Shubuta fine sandy loam A1, A2, B1, & B2
		44	Sawyer fine sandy loam A1, A2, B1 & B2
		34 & 35	Nacogdoches fine sandy loam A1, B1, B2 & B3
	IIw	2 & 12	Iuka fine sandy loam A & B
	IIs	39	Ora fine sandy loam A1 & A2
		40	Savannah fine sandy loam A1 & A2
		23	Prentiss fine sandy loam A1 & A2
		24	Tilden fine sandy loam A1 & A2
		38	Ruston fine sandy loam C1, C2, & C3
		26	Cahaba fine sandy loam C1, C2, & C3
		34 & 35	Nacogodoches fine sandy loam C1, C2 & C3
		43	Shubuta fine sandy loam C1 and C2
		44	Sawyer fine sandy loam C1 and C2
III Red on Map	IIIe	39	Ora fine sandy loam C1 and C2
		40	Savannah fine sandy loam C1 and C2
		23	Prentiss fine sandy loam C1 and C2
		24	Tilden fine sandy loam C1 and C2
		45	Boswell fine sandy loam B1, B2, C1, & C2
		40	Pheba fine sandy loam C1 and C2
		22	Stough very fine sandy loam C1 and C2
	IIIw	3 & 13	Mantachie soils
		6	Catalpa clay
		11	Johnston loam
		90	Eustis loamy sand A1, A2, B1, B2, C1, & C2
		27	Independence loamy fine sand A1, A2, B1, B2, C1, & C2
	IIIs	45	Boswell fine sandy loam A1 and A2
		40	Pheba fine sandy loam A1, A2, B1, & B2
		22	Stough very fine sandy loam A1, A2, B1, & B2
		38	Ruston fine sandy loam D1, D2, & D3
		26	Cahaba fine sandy loam D1, D2, & D3
		34	Nacogdoches fine sandy loam D1, D2, & D3
		43	Shubuta fine sandy clay loam B3, D2, & D3
IV Blue	IVe	39	Ora fine sandy loam C3, D1, & D2
		40	Savannah fine sandy loam C3, D1, & D2
		23	Prentiss very fine sandy loam C3, D1, & D2
		24	Tilden very fine sandy loam C3, D1, & D2
		88	Mayhew sandy clay loam B1, B2, C1, & C2
	IVs	4 & 9	Bibb soils
		5 & 8	Chastain soils
		88	Mayhew sandy clay loam A1 & A2
	IVw	7	Houlka clay
V Green	Vw	10 & 15	Una clay
		71, 72 & 73	Eutaw-Vaiden clays A
	Vs	21	Mayatt very fine sandy loam A1, A2, B1, & B2
		43	Cuthbert fine sandy loam A1, A2, B1, & B2
VI Orange	VIe	38	Ruston fine sandy loam E1, E2, & E3
		34 & 35	Nacogdoches fine sandy loam E1, E2, & E3
		43	Shubuta fine sandy loam C3, D3, E1, E2, & E3
		44	Sawyer fine sandy loam C3, D3, E1, E2, & E3
		45	Boswell fine sandy loam D1, D2, E1, & E2
		46	Lauderdale stony fine sandy loam C1, C2, D1, D2, E1, & E2
		47	Lauderdale-Boswell soils C1, C2, D1, D2, E1, & E2
		43	Cuthbert fine sandy loam C1, C2, D1, D2, E1, E2, E3, B3, C3, & D3
	VIs	74	Negreet clay B1, B2, C1, C2, C3, D2, D3
		75	Sumter clay B1, B2, C1, C2, C3, D2, D3
		90	Eustis loamy sand D1, D2, E1, & E2
		27	Independence loamy fine sand D1, D2, E1, E2
VII Brown	VIIe	38	Ruston fine sandy loam F1, F2, & F3
		34 & 35	Nacogdoches fine sandy loam F1, F2, & F3
		43	Shubuta fine sandy loam F1, F2, & F3
		46	Lauderdale stony fine sandy loam F1, F2, & F3
		47	Lauderdale-Boswell soils C3, D3, & E3
		43	Cuthbert fine sandy loam F1, F2, & F3
	VIIs	90	Eustis loamy sand F1

Table 2. Estimated Average Acre Yields of Principal Crops on the Soils of Newton County, Mississippi Under Two Levels of Management.

Soil No.	Soil Group	Soil Type and Phase	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Pastures, acres per animal unit A	Pastures, acres per animal unit B
1	3	Ochlockonee fine sandy loam level phase	400	600	45	85	50	100	2	1
2A	3	Iuka fine sandy loam level phase	400	600	45	85	50	100	2	1
2B	3	Iuka fine sandy loam, gently undulating phase	400	600	45	85	50	100	2	1
3A	6	Mantachie fine sandy loam level phase	400	600	45	85	50	100	2	1
3B	6	Mantachie fine sandy loam, gently undulating phase	400	600	45	85	50	100	2	1
4A	10	Bibb fine sandy loam, level phase	—	—	—	—	—	—	4	3
4B	10	Bibb fine sandy loam, gently undulating phase	—	—	—	—	—	—	4	3
5A	10	Urbo fine sandy loam, level phase	—	—	—	—	—	—	3	2
6A	6	Catalpa clay, level phase	—	450	—	50	—	80	3	2
6B	6	Catalpa clay, local alluvium, gently undulating phase	—	450	—	50	—	80	3	2
7A	9	Houlka clay, level phase	—	—	—	—	—	60	3	2
7B	9	Houlka clay, gently undulating phase	—	—	—	—	—	60	3	2
8A	10	Chastain fine sandy loam, level phase	—	—	—	—	—	—	3	2
9A	10	Bibb silt loam, level phase	—	—	—	—	—	—	4	3
10A	11	Una clay, level phase	—	—	—	—	—	—	4	3
10B	11	Una clay, gently undulating phase	—	—	—	—	—	—	4	3
11A	6	Johnston loam, level phase	—	—	40	80	50	90	3	2
11B	6	Johnston loam, gently undulating phase	—	—	40	80	50	90	3	2
12A	3	Iuka fine sandy loam, local alluvium, level phase	400	600	45	85	50	100	2	1
12B	3	Iuka fine sandy loam, local alluvium gently undulating phase	400	600	45	85	50	100	2	1
13A	3	Mantachie fine sandy loam, local alluvium level phase	400	600	45	85	50	100	2	1
13B	3	Mantachie fine sandy loam, local alluvium gently undulating phase	400	600	45	85	50	100	2	1
14A	3	Ochlockonee fine sandy loam, local alluvium level phase	450	700	45	85	50	100	2	1
15A	11	Una clay, local alluvium level phase	—	—	—	—	—	—	4	3
16A	6	Tuscumbia silty clay, level phase	—	450	—	50	—	80	3	2
21A1	12	Myatt very fine sandy loam, level phase	—	—	—	—	—	—	4	3
21B1	12	Myatt very fine sandy loam, gently undulating phase	—	—	—	—	—	—	4	3
21B2	12	Myatt very fine loam, eroded gently undulating phase	—	—	—	—	—	—	4	3
22A1	7	Stough very fine sandy loam, level phase	—	—	30	55	40	60	4	3
22B1	7	Stough very fine sandy loam, gently undulating	—	—	30	55	40	60	4	3
22B2	7	Stough very fine sandy loam, eroded gently undulating phase	—	—	30	55	40	60	4	3
22C2	5	Stough very fine sandy loam, eroded undulating phase	—	—	30	55	40	60	4	3
23A1	4	Prentiss very fine sandy loam level phase	350	500	35	60	40	65	4	3
23A2	4	Prentiss very fine sandy loam eroded level phase	350	500	35	60	40	65	4	3
23B1	2	Prentiss very fine sandy loam, gently undulating phase	350	500	35	60	40	65	4	3
23B2	2	Prentiss very fine sandy loam, eroded gently undulating phase	350	500	35	60	—	—	—	—
23B3	2	Prentiss very fine sandy loam, severely eroded gently undulating phase	350	500	35	60	—	—	—	—

Table 2. (Continued)

Soil No.	Soil Group	Soil Type and Phase	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Pastures, acres per animal unit A	Pastures, acres per animal unit B
23C1	5	Prentiss very fine sandy loam, undulating phase	300	450	30	50	40	60	4	3
23C2	5	Prentiss very fine sandy loam, eroded undulating phase	300	450	30	50	40	60	4	3
23C3	5	Prentiss very fine sandy loam, severely eroded undulating phase	300	450	30	50	40	60	4	3
23D1	8	Prentiss very fine sandy loam, gently rolling phase	—	—	—	—	—	—	4	3
23D2	8	Prentiss very fine sandy loam, eroded gently rolling phase	—	—	—	—	—	—	4	3
23D3	8	Prentiss very fine sandy loam, severely eroded gently rolling phase	—	—	—	—	—	—	4	3
24A1	4	Tilden very fine sandy loam level phase	400	600	40	70	45	80	3	2
24A2	4	Tilden very fine sandy loam, eroded level phase	400	600	40	70	45	80	3	2
24B1	2	Tilden very fine sandy loam, gently undulating phase	400	600	40	70	45	80	3	2
24B2	2	Tilden very fine sandy loam, eroded gently undulating phase	395	550	35	65	40	70	3	2
24B3	2	Tilden very fine sandy loam, severely eroded gently undulating phase	350	500	—	—	30	60	3	2
24C1	5	Tilden very fine sandy loam, undulating phase	350	600	35	65	40	70	3	2
24C2	5	Tilden very fine sandy loam, eroded undulating phase	350	600	35	65	40	70	3	2
24C3	5	Tilden very fine sandy loam, severely eroded undulating phase	—	—	—	—	—	—	3	2
24D1	8	Tilden very fine sandy loam, gently rolling phase	—	—	—	—	—	—	4	3
24D2	8	Tilden very fine sandy loam, eroded gently rolling phase	—	—	—	—	—	—	4	3
24D3	8	Tilden very fine sandy loam, severely eroded gently rolling phase	—	—	—	—	—	—	4	3
24E2	8	Tilden very fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
25A1	4	Flint very fine sandy loam, level phase	400	600	40	70	45	80	3	2
25B2	2	Flint very fine sandy loam, eroded gently undulating phase	400	600	40	70	45	80	3	2
25C2	5	Flint very fine sandy loam, eroded gently undulating phase	350	600	35	65	40	70	—	—
25D2	5	Flint very fine sandy loam, eroded gently rolling phase	—	—	—	—	—	—	4	3
26A1	1	Cahaba very fine sandy loam, level phase	400	625	45	75	50	100	3	2
26B1	2	Cahaba very fine sandy loam, gently undulating phase	400	625	45	75	50	100	3	2
26B2	2	Cahaba very fine sandy loam, eroded gently undulating phase	400	625	45	75	50	100	3	2
26B3	2	Cahaba very fine sandy loam, severely eroded, gently undulating phase	350	600	35	60	40	90	3	2
26C1	5	Cahaba very fine sandy loam, undulating phase	350	600	35	60	40	90	3	2
26C2	5	Cahaba very fine sandy loam, eroded undulating phase	350	600	35	60	40	90	3	2
26C3	5	Cahaba very fine sandy loam, severely eroded undulating phase	300	500	25	45	35	65	4	3
26D1	8	Cahaba very fine sandy loam, gently rolling phase	150	350	20	40	30	60	5	3.5
26D2	8	Cahaba very fine sandy loam, eroded gently rolling phase	150	350	20	40	30	60	5	3.5
26D3	8	Cahaba very fine sandy loam, severely eroded gently rolling phase	150	350	20	40	30	60	5	3.5
26F1	15	Cahaba very fine sandy loam, hilly phase	—	—	—	—	—	—	5	3.5
26F2	15	Cahaba very fine sandy loam, eroded hilly phase	—	—	—	—	—	—	5	3.5
27A1	7	Independence loamy fine sand, level phase	200	300	20	40	30	60	4	3
27B1	7	Independence loamy fine sand, gently undulating phase	200	300	20	40	30	60	4	3
27B2	7	Izagora loamy fine sand, eroded gently undulating phase	200	300	20	40	30	60	4	3
27C1	7	Izagora loamy fine sand undulating phase	200	300	20	40	30	60	4	3
28A1	3	Izagora very fine sandy loam, level phase	—	—	30	55	40	60	4	3
28B2	3	Izagora very fine sandy loam, eroded gently undulating phase	—	—	30	55	40	60	4	3
28C2	5	Izagora very fine sandy loam, eroded undulating phase	—	—	30	55	40	60	4	3

Table 2. (Continued)

Soil No.	Soil Group	Soil Type and Phase	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Pastures, acres per animal unit A	Pastures, acres per animal unit B
30A1	7	Huckabee loamy fine sand, level phase	200	300	20	40	30	60	4	3
30B1	7	Huckabee loamy fine sand, gently undulating phase	200	300	20	40	30	60	4	3
30C1	7	Huckabee loamy fine sand, undulating phase	200	300	20	40	30	60	4	3
30D1	14	Huckabee loamy fine sand, gently rolling phase	200	300	20	40	30	60	4	3
33C2	5	Orangeburg sandy loam, eroded undulating phase	300	500	25	45	35	65	4	3
33C3	5	Orangeburg sandy loam, severely eroded undulating phase	300	500	25	45	35	65	4	3
33E1	13	Orangeburg sandy loam, rolling phase	—	—	—	—	—	—	5	3.5
33E2	13	Orangeburg sandy loam, eroded rolling phase	—	—	—	—	—	—	5	3.5
33E3	13	Orangeburg sandy loam, severely eroded rolling phase	—	—	—	—	—	—	5	3.5
33F1	15	Orangeburg sandy loam, hilly phase	—	—	—	—	—	—	5	3.5
34B2	2	Nacogdoches fine sandy loam, eroded gently undulating phase	350	550	30	55	45	75	4	3
34B3	2	Nacogdoches fine sandy loam, severely eroded, gently undulating phase	275	450	20	45	40	65	4	3
34C1	5	Nacogdoches fine sandy loam, undulating phase	350	550	30	55	45	75	4	3
34C2	5	Nacogdoches fine sandy loam, eroded undulating phase	300	500	25	50	40	70	4	3
34C3	5	Nacogdoches fine sandy loam, severely eroded undulating phase	275	450	20	45	40	65	4	3
34D1	8	Nacogdoches fine sandy loam, gently rolling phase	250	400	—	—	30	50	5	3
34D2	8	Nacogdoches fine sandy loam, eroded gently rolling phase	250	400	—	—	30	50	5	3
34D3	8	Nacogdoches fine sandy loam, severely eroded gently rolling phase	250	400	—	—	30	50	5	3
34E1	13	Nacogdoches fine sandy loam, rolling phase	—	—	—	—	—	—	—	—
34E2	13	Nacogdoches fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
34E3	13	Nacogdoches fine sandy loam, severely eroded rolling phase	—	—	—	—	—	—	—	—
34F1	13	Nacogdoches fine sandy loam, hilly phase	—	—	—	—	—	—	—	—
34F2	15	Nacogdoches fine sandy loam, eroded hilly phase	—	—	—	—	—	—	—	—
34F3	15	Nacogdoches fine sandy loam, severely eroded hilly phase	—	—	—	—	—	—	—	—
35B2	2	Nacogdoches sandy clay loam, eroded gently undulating phase	350	550	30	55	45	75	4	3
35B3	2	Nacogdoches sandy clay loam, severely eroded gently undulating phase	275	450	20	45	40	65	4	3
35C2	5	Nacogdoches sandy clay loam, eroded undulating phase	300	500	25	50	40	70	4	3
35C3	5	Nacogdoches sandy clay loam, severely eroded undulating phase	275	450	20	45	40	65	4	5
35D2	8	Nacogdoches sandy clay loam, eroded gently rolling phase	250	400	—	—	30	50	5	3
35D3	8	Nacogdoches sandy clay loam, severely eroded gently rolling phase	250	400	—	—	30	50	5	3
35E2	13	Nacogdoches sandy clay loam, eroded rolling phase	—	—	—	—	—	—	—	—
35E3	13	Nacogdoches sandy clay loam, severely eroded rolling phase	—	—	—	—	—	—	—	—
35F2	15	Nacogdoches sandy clay loam, hilly phase	—	—	—	—	—	—	—	—
36C2	5	Bub pebbly sandy clay loam, eroded undulating phase	275	450	20	45	40	70	4	3
36D2	8	Bub pebbly sandy clay loam, eroded gently rolling phase	250	400	—	—	30	50	5	3
36D3	8	Bub pebbly sandy clay loam, severely eroded gently rolling phase	250	400	—	—	30	50	5	3
36E1	13	Bub pebbly sandy clay loam, rolling phase	—	—	—	—	—	—	—	—
36E2	13	Bub pebbly sandy clay loam, eroded rolling phase	—	—	—	—	—	—	—	—
36E3	13	Bub pebbly sandy clay loam, severely eroded rolling phase	—	—	—	—	—	—	—	—
36F3	15	Bub pebbly sandy clay loam, severely eroded hilly phase	—	—	—	—	—	—	—	—
37B1	2	Luverne fine sandy loam, gently undulating phase	270	450	25	50	40	65	4	3
37B2	2	Luverne fine sandy loam, eroded gently undulating phase	270	450	25	50	40	65	4	3

Table 2. (Continued)

Soil No.	Soil Group	Soil Type and Phase	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Pastures, acres per animal unit A	Pastures, acres per animal unit B
37B3	2	Luverne fine sandy loam, severely eroded gently undulating phase	150	300	—	—	25	50	5	4
37C1	5	Luverne fine sandy loam undulating phase	200	400	20	40	30	60	4	3
37C2	5	Luverne fine sandy loam, eroded undulating phase	200	400	20	40	30	60	4	3
37C3	5	Luverne fine sandy loam, severely eroded undulating phase	150	300	—	—	25	50	5	4
37D2	8	Luverne fine sandy loam, eroded gently rolling phase	150	300	—	—	25	50	5	4
37D3	8	Luverne fine sandy loam, severely eroded gently rolling phase	150	300	—	—	25	50	5	4
37E2	13	Luverne fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
38B1	2	Ruston fine sandy loam, gently undulating phase	350	500	30	50	40	70	4	3
38B2	2	Ruston fine sandy loam, eroded gently undulating phase	350	500	30	50	40	70	4	3
38B3	2	Ruston fine sandy loam, severely eroded, gently undulating phase	300	500	25	45	35	65	4	3
38C1	5	Ruston fine sandy loam, undulating phase	300	500	25	45	35	65	4	3
38C2	5	Ruston fine sandy loam, eroded undulating phase	300	500	25	45	35	65	4	3
38C3	5	Ruston fine sandy loam, severely eroded, undulating phase	300	500	25	45	35	65	4	3
38D1	8	Ruston fine sandy loam, gently rolling phase	150	350	20	40	30	60	5	3.5
38D2	8	Ruston fine sandy loam, eroded gently rolling phase	150	350	20	40	30	60	5	3.5
38D3	8	Ruston fine sandy loam, severely eroded, gently rolling phase	150	350	20	40	30	60	5	3.5
38E1	13	Ruston fine sandy loam, rolling phase	—	—	—	—	—	—	—	—
38E2	13	Ruston fine sandy loam, eroded rolling phase	—	—	—	—	—	—	5	3.5
38E3	13	Ruston fine sandy loam, severely eroded rolling phase	—	—	—	—	—	—	5	3.5
38E4	13	Ruston fine sandy loam, very severely eroded, rolling phase	—	—	—	—	—	—	—	—
38F1	15	Ruston fine sandy loam, hilly phase	—	—	—	—	—	—	5	3.5
38F2	15	Ruston fine sandy loam, eroded hilly phase	—	—	—	—	—	—	5	3.5
38F3	15	Ruston fine sandy loam, severely eroded hilly phase	—	—	—	—	—	—	5	3.5
39A1	4	Ora fine sandy loam, level phase	275	450	25	40	30	60	4	3
39B1	2	Ora fine sandy loam, gently undulating phase	275	450	25	40	30	60	4	3
39B2	2	Ora fine sandy loam, eroded gently undulating phase	275	450	25	40	30	60	4	3
39B3	2	Ora fine sandy loam. severely eroded, gently undulating phase	150	300	—	—	30	50	5	3
39C1	5	Ora fine sandy loam, undulating phase	200	400	20	40	30	55	5	3.5
39C2	5	Ora fine sandy loam, eroded undulating phase	200	400	20	40	30	55	5	3.5
39C3	8	Ora fine sandy loam, severely eroded undulating phase	150	300	—	—	30	50	5	3
39D1	8	Ora fine sandy loam, gently rolling phase	150	300	—	—	30	50	5	3
39D2	8	Ora fine sandy loam, eroded gently rolling phase	150	300	—	—	30	50	5	3
39D3	8	Ora fine sandy loam, severely eroded undulating phase	—	—	—	—	—	—	5	3
40A2	4	Savannah fine sandy loam, eroded, level phase	300	500	25	45	40	60	4	3
40B1	2	Savannah fine sandy loam, gently undulating phase	300	500	25	45	40	60	4	3
40B2	2	Savannah fine sandy loam, eroded gently undulating phase	300	500	25	45	40	60	4	3
40B3	2	Savannah fine sandy loam, severely eroded gently undulating phase	150	300	—	—	30	50	4	3
40C1	5	Savannah fine sandy loam, undulating phase	250	400	20	45	40	60	4	3
40C2	5	Savannah fine sandy loam, eroded undulating phase	250	400	20	45	40	60	4	3
40C3	5	Savannah fine sandy loam, severely eroded undulating phase	150	300	—	—	30	50	5	3
40D2	5	Savannah fine sandy loam, eroded gently rolling phase	150	300	—	—	30	50	5	3
40D3	5	Savannah fine sandy loam, severely eroded gently rolling phase	—	—	—	—	—	—	5	3
41A1	4	Pheba fine sandy loam, level phase	300	500	25	45	40	60	4	3
41B1	2	Pheba fine sandy loam, gently undulating phase	300	500	25	45	40	60	4	3

Table 2. (Continued)

Soil No.	Soil Group	Soil Type and Phase	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Pastures, acres per animal unit A	Pastures, acres per animal unit B
41B2	2	Pheba fine sandy loam, eroded gently undulating phase	300	500	25	45	40	60	4	3
41C2	5	Pheba fine sandy loam, eroded undulating phase	250	400	20	45	40	60	4	3
41C3	5	Pheba fine sandy loam, severely eroded undulating phase	150	300	—	—	30	50	5	3
43B1	2	Shubuta fine sandy loam, gently undulating phase	270	450	25	50	40	65	4	3
43B2	2	Shubuta fine sandy loam, eroded gently undulating phase	270	450	25	50	40	65	4	3
43B3	8	Shubuta fine sandy loam, severely eroded gently undulating phase	150	300	—	—	25	50	4	3
43C1	5	Shubuta fine sandy loam, undulating phase	200	400	20	40	30	60	4	3
43C2	5	Shubuta fine sandy loam, eroded undulating phase	200	400	20	40	30	60	4	3
43C3	13	Shubuta fine sandy loam, severely eroded undulating phase	150	300	—	—	25	50	4	3
43D1	8	Shubuta fine sandy loam, gently rolling phase	150	300	—	—	25	50	4	3
43D2	8	Shubuta fine sandy loam, eroded gently undulating phase	150	300	—	—	25	50	4	3
43D3	13	Shubuta fine sandy loam, severely eroded gently rolling phase	150	300	—	—	25	50	4	3
43E1	13	Shubuta fine sandy loam, rolling phase	—	—	—	—	—	—	—	—
43E2	13	Shubuta fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
43E3	13	Shubuta fine sandy loam, severely eroded rolling phase	—	—	—	—	—	—	—	—
43E4	15	Shubuta fine sandy loam, very severely eroded rolling phase	—	—	—	—	—	—	—	—
43F1	15	Shubuta fine sandy loam, hilly phase	—	—	—	—	—	—	—	—
43F2	15	Shubuta fine sandy loam, eroded hilly phase	—	—	—	—	—	—	—	—
43F3	15	Shubuta fine sandy loam, severely eroded hilly phase	—	—	—	—	—	—	—	—
44A1	7	Angie fine sandy loam, level phase	270	450	25	50	40	65	4	3
44A2	7	Angie fine sandy loam, eroded level phase	270	450	25	50	40	65	4	3
44B1	5	Angie fine sandy loam, gently undulating phase	270	450	25	50	40	65	4	3
44B2	5	Angie fine sandy loam, eroded gently undulating phase	270	450	25	50	40	65	4	3
44B3	5	Angie fine sandy loam, severely eroded gently undulating phase	150	300	—	—	25	50	5	4
44C1	5	Angie fine sandy loam, undulating phase	200	400	20	40	30	60	4	3
44C2	5	Angie fine sandy loam, eroded undulating phase	200	400	20	40	30	60	4	3
44C3	5	Angie fine sandy loam, severely eroded undulating phase	150	300	—	—	25	50	5	4
44D1	13	Angie fine sandy loam, gently rolling phase	150	300	—	—	25	50	5	4
44D2	13	Angie fine sandy loam, eroded gently rolling phase	150	300	—	—	25	50	5	4
44D3	13	Angie fine sandy loam, severely eroded phase	—	—	—	—	—	—	5	4
44E1	13	Angie fine sandy loam, rolling phase	—	—	—	—	—	—	—	—
44E3	13	Angie fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
45B1	5	Boswell fine sandy loam, gently undulating phase	200	350	—	—	30	60	4	3
45B2	5	Boswell fine sandy loam, eroded gently undulating phase	200	350	—	—	30	60	4	3
45B3	5	Boswell fine sandy loam, severely eroded gently undulating phase	—	—	—	—	—	—	5	4
45C1	5	Boswell fine sandy loam, undulating phase	200	300	—	—	30	60	4	3
45C2	5	Boswell fine sandy loam, eroded undulating phase	200	300	—	—	30	60	4	3
45C3	8	Boswell fine sandy loam, severely eroded undulating phase	—	—	—	—	—	—	5	4
45D1	13	Boswell fine sandy loam, gently rolling phase	200	300	—	—	25	50	5	3
45D2	13	Boswell fine sandy loam, eroded gently rolling phase	200	300	—	—	25	50	5	3
45D3	15	Boswell fine sandy loam, severely eroded gently rolling phase	—	—	—	—	—	—	5	4
45E1	13	Boswell fine sandy loam, rolling phase	—	—	—	—	—	—	—	—
45E2	13	Boswell fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
45E3	13	Boswell fine sandy loam, severely eroded rolling phase	—	—	—	—	—	—	—	—
45F1	15	Boswell fine sandy loam, hilly phase	—	—	—	—	—	—	—	—
45F2	15	Boswell fine sandy loam, eroded hilly phase	—	—	—	—	—	—	—	—
45F3	15	Boswell fine sandy loam, severely eroded hilly phase	—	—	—	—	—	—	—	—

Table 2. (Continued)

Soil No.	Soil Group	Soil Type and Phase	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Pastures, acres per animal unit A	Pastures, acres per animal unit B
46C1	13	Lauderdale stony fine sandy loam, undulating phase	—	—	—	—	—	—	—	—
46C2	13	Lauderdale stony fine sandy loam, eroded undulating phase	—	—	—	—	—	—	—	—
46C3	13	Lauderdale stony fine sandy loam, severely eroded undulating phase	—	—	—	—	—	—	—	—
46D2	13	Lauderdale stony fine sandy loam. eroded gently rolling phase	—	—	—	—	—	—	—	—
46E1	13	Lauderdale stony fine sandy loam, rolling phase	—	—	—	—	—	—	—	—
46E2	13	Lauderdale stony fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
46F1	15	Lauderdale stony fine sandy loam, hilly phase	—	—	—	—	—	—	—	—
46F2	15	Lauderdale stony fine sandy loam, eroded hilly phase	—	—	—	—	—	—	—	—
47C1	13	Lauderdale-Boswell soils, undulating phase	—	—	—	—	—	—	—	—
47C2	13	Lauderdale-Boswell soils, eroded undulating phase	—	—	—	—	—	—	—	—
47C3	13	Lauderdale-Boswell soils, severely eroded undulating phase	—	—	—	—	—	—	—	—
47D1	13	Lauderdale-Boswell soils, gently rolling phase	—	—	—	—	—	—	—	—
47D2	13	Lauderdale-Boswell soils, eroded gently rolling phase	—	—	—	—	—	—	—	—
47D3	13	Lauderdae-Boswell soils, severely eroded genty rolling phase	—	—	—	—	—	—	—	—
47E1	13	Lauderdale-Boswell soils, rolling phase	—	—	—	—	—	—	—	—
47E2	13	Lauderdale-Boswell soils, eroded rolling phase	—	—	—	—	—	—	—	—
47E3	13	Lauderdale-Boswell soils, severely eroded rolling phase	—	—	—	—	—	—	—	—
47F1	15	Lauderdale-Boswell soils, hilly phase	—	—	—	—	—	—	—	—
47F2	15	Lauderdale-Boswell soils, eroded hilly phase	—	—	—	—	—	—	—	—
48E2	13	Cuthbert fine sandy loam, eroded rolling phase	—	—	—	—	—	—	—	—
48E3	13	Cuthbert fine sandy loam, severely eroded rolling phase	—	—	—	—	—	—	—	—
48F1	15	Cuthbert fine sandy loam, hilly phase	—	—	—	—	—	—	—	—
48F2	15	Cuthbert fine sandy loam, eroded hilly phase	—	—	—	—	—	—	—	—
48F3	15	Cuthbert fine sandy loam, severely eroded hilly phase	—	—	—	—	—	—	—	—
71A1	10	Eutaw clay, level phase	—	—	—	—	—	—	3	2
71A2	10	Eutaw clay, eroded level phase	—	—	—	—	—	—	3	2
71B1	10	Eutaw clay, gently undulalting phase	—	—	—	—	—	—	3	2
71B2	10	Eutaw clay, eroded gently undulating phase	—	—	—	—	—	—	3	2
71C1	10	Eutaw clay, undulating phase	—	—	—	—	—	—	3	2
71C2	10	Eutaw clay, eroded undulating phase	—	—	—	—	—	—	3	2
71C3	10	Eutaw clay, severely eroded undulating phase	—	—	—	—	—	—	3	2
71D2	10	Eutaw clay, eroded gently rolling phase	—	—	—	—	—	—	3	2
72A1	10	Eutaw-Vaiden clays, level phase	—	—	—	—	—	—	3	2
72B2	10	Eutaw-Vaiden clays, eroded gently undulating phase	—	—	—	—	—	—	3	2
73A1	7	Vaiden clay, level phase	200	400	—	—	30	60	3	2
73B1	10	Vaiden clay, gently undulating phase	200	400	—	—	30	60	3	2
73B2	10	Vaiden clay, eroded gently undulating phase	200	400	—	—	30	60	3	2
73C1	13	Vaiden clay, undulating phase	200	400	—	—	30	60	3	2
73C2	13	Vaiden clay, eroded undulating phase	200	400	—	—	30	60	3	2
73C3	13	Vaiden clay, severely eroded undulating phase	—	—	—	—	—	—	4	3
73D1	13	Vaiden clay, gently rolling phase	—	—	—	—	—	—	4	3
73D2	13	Vaiden clay, eroded gently rolling phase	—	—	—	—	—	—	4	3
73D3	13	Vaiden clay, severely eroded gently rolling phase	—	—	—	—	—	—	4	3

Table 2. (Continued)

Soil No.	Soil Group	Soil Type and Phase	Cotton Lbs. A	Cotton Lbs. B	Corn Bu. A	Corn Bu. B	Oats Bu. A	Oats Bu. B	Pastures, acres per animal unit A	Pastures, acres per animal unit B
74A2	13	Negreet clay, eroded level phase	—	—	—	—	—	—	4	3
74B1	13	Negreet clay, gently undulating phase	—	—	—	—	—	—	4	3
74B2	13	Negreet clay, eroded gently undulating phase	—	—	—	—	—	—	4	3
74B3	13	Negreet clay, severely eroded gently undulating phase	—	—	—	—	—	—	4	3
74C1	13	Negreet clay, undulating phase	—	—	—	—	—	—	4	3
74C2	13	Negreet clay, eroded undulating phase	—	—	—	—	—	—	4	3
74C3	13	Negreet clay, severely eroded undulating phase	—	—	—	—	—	—	4	3
74D2	13	Negreet clay, eroded gently rolling phase	—	—	—	—	—	—	4	3
74D3	13	Negreet clay, severely eroded gently rolling phase	—	—	—	—	—	—	4	3
75B2	2	Sumter clay, eroded gently undulating phase	—	—	—	—	—	—	4	3
75C1	5	Sumter clay, undulating phase	—	—	—	—	—	—	4	3
75C2	5	Sumter clay, eroded undulating phase	—	—	—	—	—	—	4	3
75C3	13	Sumter clay, severely eroded undulating phase	—	—	—	—	—	—	4	3
75D2	13	Sumter clay, eroded gently rolling phase	—	—	—	—	—	—	4	3
75D3	13	Sumter clay, severely eroded gently rolling phase	—	—	—	—	—	—	4	3
88A1	10	Mayhew fine sandy loam, level phase	—	—	—	—	—	—	4	3
88A2	10	Mayhew fine sandy loam, eroded level phase	—	—	—	—	—	—	4	3
88B1	10	Mayhew fine sandy loam, gently undulating phase	—	—	—	—	—	—	4	3
88B2	10	Mayhew fine sandy loam, eroded gently undulating phase	—	—	—	—	—	—	4	3
88C2	10	Mayhew fine sandy loam, eroded undulating phase	—	—	—	—	—	—	4	3
90A1	7	Eustis loamy sand, dark surface, level phase	200	350	20	45	30	50	5	3
90B1	7	Eustis loamy sand, dark surface, gently undulating phase	200	350	20	45	30	50	5	3
90B2	7	Eustis loamy sand, dark surface, eroded gently undulating phase	200	350	20	45	30	50	5	3
90C1	7	Eustis loamy sand, dark surface, undulating phase	200	350	20	45	30	50	5	3
90C2	7	Eustis loamy sand, dark surface, eroded undulating phase	200	350	20	45	30	50	5	3
90D1	14	Eustis loamy sand, dark surface, gently rolling phase	150	300	—	—	25	45	5	3
90D2	14	Eustis loamy sand, dark surface, eroded gently rolling phase	150	300	—	—	25	45	5	4
90D3	14	Eustis loamy sand, dark surface, severely eroded gently rolling phase	150	300	—	—	25	45	5	4
90E1	14	Eustis loamy sand, dark surface, rolling phase	—	—	—	—	—	—	6	4
90E2	14	Eustis loamy sand, dark surface, eroded rolling phase	—	—	—	—	—	—	6	4
90F1	16	Eustis loamy sand, dark surface, hilly phase	—	—	—	—	—	—	6	4

LAND USE AND MANAGEMENT FOR VARIOUS SOIL GROUPS

(Numbers correspond to second column in table above)

1. Well adapted for all uses: row crops, small grain, truck crops, grasses and pine trees. Good rotation systems, one-third of the time in close-growing crops and two-thirds in row crops with cover crops and crop residues; or one-half time in sod and one-half in row crops with cover crops. Row arrangement may be needed to remove surface water and diversion ditches where hillside water is a problem.

2. Well adapted for most row crops, small grains, truck crops, grasses, and pine trees. To produce moderately high yields of adapted crops and prevent erosion land needs at least one-half of the time in close-growing crops and one-half row crops or four years of sod and two years of row crops with cover crops. Needs vegetated outlets, terraces, and rows on the contour.

3. Similar to 2 above but differs in that water is major hazard rather than erosion. Good for most row crops, small grains, vetch, winter peas, and lespedeza. Pine and hardwoods well adapted. Good cropping system is row crop with high fertilization and legumes and two years close-growing crops, or one-third sod and two-thirds row crops with legumes. Row arrangement and V and W ditches needed to remove excess surface water. Diversion ditches may also be needed.

4. Soil is the hazard rather than erosion and water. Found on level slopes and have a hard pan. Crops often suffer during both dry and wet weather. Vetch, winter peas, millet, sudan, sorghum, lespedeza, grasses and pine trees well adapted. Cotton, corn, small grains and sericea are fairly well adapted. Good cropping systems are one-third close-growing crops and two-thirds row crops, or one-half sod and one-half row crops with a winter cover crop. Organic matter should be built up and maintained. Row arrangement and W-ditches needed. Diversions may be needed where hillside water is a problem.

5. Generally adapted to row crops, however, better suited to sod crops and pine trees. Adapted cropping system to conserve soil and produce moderately high yields is four years of sod or Sericea and two years of row crops with cover crops. Land should be terraced, have vegetated outlets and rows placed on the contour. When in row crops, rows should be arranged with care to avoid excessive soil loss.

6. Well adapted to corn, soybeans, millet, sudan, sorghum, lespedeza and most all grasses and clovers. Cotton, vetch and small grains are fairly well adapted. Adequate cropping systems are high fertilization of row crops with cover crops and proper management of crop residue, three years small grain and three years row crops with cover crops, or three years of grasses and legumes followed by three years of row crops with high fertilization and proper use of crop residue. Usually good drainage system is needed. Rows should be arranged to provide surface drainage.

7. Soil is major hazard. Such crops as cotton, corn, soybeans, sorghum, millet, sudan, small grains, vetch and winter peas are fairly well adapted, as are most grasses and clovers and pine trees. Adapted cropping systems are three years close-growing crops with three years row crops with cover crops, and two years small grain and lespedeza and one year row crops. Row arrangement, W-ditches, terraces and vegetated outlets may be needed.

8. Have steep slopes and are badly eroded. Adapted to cotton, corn, truck crops, sericea, kudzu, lespedeza, sorghum, most grasses and clovers and pine trees. When row-cropped it should be only one year out of four. Good cropping systems to follow are six years of sod and two years row crops with cover crops, or three years of sericea and one year of row crops. If necessary to use for row crops it should have vegetated outlets, be terraced where practical, and have rows on the contour.

9. Best suited for grasses and clovers, however, can be used for row crops if properly managed. Crops such as soybeans, sorghum, vetch and oats fairly well adapted. Cotton and corn poor risk. When used for row crops the cropping system should be six years of sod and two of row crops with cover crops. Needs complete drainage system including secondary ditches with W-ditches and proper row arrangement to remove excess surface water.

10. Wet land with low fertility level. Poor risk for such crops as cotton and corn. Fairly well adapted to soybeans, sorghum, vetch and oats. Bermuda, dallis grass, fescue, white clover and wild winter peas well adapted as are hardwoods. When necessary to row crop a cropping system of six years sod and two of row crops with cover crops, or four years sod and two years row crops with cover crops is recommended. This land needs complete drainage system including secondary ditches with W-ditches and proper row arrangement to remove excess surface water.

11. Heavy texture and poor drainage. Best adapted to grasses and clovers. Not recommended for row crops. Adapted to hardwoods and pines. When used for pasture it needs V- and W-ditches to remove excess surface water.

12. Not recommended for cultivation. Well adapted to Bermuda grass, annual lespedeza, bahia grass, dallis grass, and white clover. Pine and hardwood trees also well adapted. Adequate drainage must be provided to grow above grasses and legumes.

13. Best suited for trees. However, adapted plants such as Bermuda, Bahia grass, sericea, kudzu, and crimson clover will produce good pasture. When used for pasture it is essential to have good ground cover so as to prevent erosion.

14. Differs from 13 in that the soil is hazard rather than erosion. Use and management treatment are the same as for 13.

15. Best suited for pine trees, however, Bermuda grass, sericea, and kudzu do fairly well. Where grasses and legumes are grown well managed permanent cover is needed to prevent erosion.

16. Best suited to growing pine trees. Most all the soil is deep sands.

Soil Series of Newton County

Bibb Series

The Bibb Series includes gray poorly drained sandy and silty soils on stream flood plains. The soils have formed from materials that have washed from Ora, Savannah, Shubuta and associated soils. The Bibb soils are found in association with the Ochlockonee, Iuka, and Mantachie soils. They always occupy the lowest elevation in the flood plain and are the poorest drained. These are acid soils and have a low fertility level. Due to low fertility, poor drainage, and frequency of flooding they are hazardous for cultivation. These soils are fairly well distributed throughout the county and are adapted for hardwood timber and pasture.

Boswell Series

The Boswell Series includes upland soils that are imperfect or somewhat poorly drained. These soils have developed from acid sands and clays. They have gray surfaces and red subsoils in the upper part and mottled in lower part. These soils occur on very gently sloping to moderately steep slopes. The fertility level is low and the soils are very susceptible to erosion. Due to these conditions the soils are better suited to growing grass and trees than row crops.

Cahaba Series

The Cahaba Series includes the deep well drained soils on stream terraces. These soils were formed from materials that have washed from such soils as Ruston, Nacogdoches, Ora, Savannah and Shubuta. They have sandy surfaces that are gray to yellowish-brown in color. The subsoils are red or yellowish-red. These soils are fertile and well adapted to all crops grown in the county. The acreage is limited but they are important agriculturally. The profile is acid throughout, but responds well to lime, fertilizers and good soil management.

Catalpa Series

The Catalpa Series includes the grayish-brown calcareous alluvial soils which are found in the prairie section of the county. These soils have formed from materials that have washed from such soils as Sumter, Negreet and similar soils. They are of limited acreage and are found along small streams. They are adapted for grasses, feed crops and taprooted plants. These soils are alkaline in reaction.

Chastain Series

The Chastain Series includes gray poorly drained soils on stream flood plains that are underlain by heavy clays. These soils are similar to the Bibb soils but differ from them by being underlain by the heavy clay. Like the Bibb soils they are poor risks for row crops but are suited for hardwood timber. The acreage of these soils in the county is small and they are not important to agriculture in the county.

Cuthbert Series

The Cuthbert soils have gray or grayish brown surfaces and yellowish-red subsoils of clay. These soils are moderately well drained. They do not occur in large areas and are suited for pine timber. The profile is acid throughout.

Eustis Series

The Eustis Series includes deep sandy soils that are somewhat excessively drained. The surfaces are dark grayish-brown in color and subsoils are reddish-yellow. These soils are found in association with Ruston soils. They do not occur in large areas nor are they widely distributed. They are acid in reaction, droughty, and are not important to agriculture of the county. They can be used for early truck crops.

Eutaw Series

The Eutaw Series includes the poorly drained soils with gray surfaces and subsoils of mottled gray and yellow clay. These soils have formed from thin beds of clay (less than four feet) over marl and chalk. They are known locally as "post oak prairie or crawfish prairies". They are found in association with the Vaiden soils which are better drained. These soils are found in fairly large bodies and are well suited to grasses and trees. They are acid in reaction in the top three feet.

Houlka Series

The Houlka Series includes the imperfectly drained brownish-gray to black acid alluvial soils in the prairie. These soils are formed from materials that have washed from the Vaiden, Eutaw, Sawyer and associated soils. The acreage of these soils is not large in Newton County. They are adapted and used primarily for pastures and taprooted crops.

Independence Series

The Independence Series includes the deep, somewhat excessively drained sandy soils that occur on stream terraces. They have gray surfaces and pale brown subsoils. They are similar to the upland Eustis soils. The fertility level of these soils is low and they are acid in reaction. The total acreage is small and they are not important to agriculture, but can be used for early truck crops.

Iuka Series

The Iuka Series includes moderately well drained gray or grayish brown sandy soils on stream flood plains. These soils have formed from materials washed from such soils as Ruston, Ora, Savannah, Shubuta, and associated soils. The Iuka soils are found in association with the Mantachie and Bibb soils, but are more fertile and better drained. These are productive soils and are fairly well distributed throughout the county. These soils are acid in reaction and are well suited for corn and other row crops.

Lauderdale Series

The Lauderdale Series includes well drained to somewhat excessively drained shallow soils. They have gray surfaces. These soils have formed from sandstones in the Tallahatta formation. They are found in association with Boswell and Shubuta soils. They differ from these soils in being underlain by sandstone rather than of unconsolidated materials. These soils are non-agricultural or timber soils and occur primarily in the northeastern part of the county.

Johnston Series

The Johnston Series includes the dark colored poorly drained bottom soils. These soils are derived from decayed grasses and woody plants. They usually are found in the low depressional areas and at base of slopes. The surfaces are high in organic matter. These are fairly good soils where proper drainage has been applied.

Mantachie Series

The Mantachie Series includes the imperfectly drained sandy alluvial soils on stream flood plains. They have gray or grayish-brown surfaces. These soils have formed from materials that have washed from the Ruston, Savannah, Ora, and Shubuta soils. The Mantachie soils occupy somewhat lower elevations than do the better drained Ochlockonee and Iuka soils. Mantachie is the dominant series found on the flood plains. The acreage is extensive and the soils are important to the agriculture of the county. The soils are acid in reaction and are well adapted to corn, pastures and hay crops.

Mayhew Series

The Mayhew Series includes the gray acid poorly drained soils that occur adjacent to the prairie. The subsoils are gray with yellowish-brown mottles. These soils have been formed from thick (more than four feet thick) of micaceous clays. They resemble the Eutaw soils with which they are associated but differ from them in having sandy clay subsoils and not having calcareous material within the Solum. The acreage of these soils is limited and they are not important to the agriculture. They are suited for pastures and trees.

Myatt Series

The Myatt Series includes the gray poorly drained sandy soils found on the stream terraces. These soils are derived from materials that have washed from such soils as Savannah, Ora, Shubuta, and Ruston. The Myatt soils are found in association with the Tilden, Prentiss, and Stough soils. They are the poorest drained member of this Catena. The fertility level of these soils is low. Due to poor drainage and low fertility level they are a poor risk for row crops and are better adapted to pasture and trees. They are acid in reaction.

Nacogdoches Series

The Nacogdoches Series includes well-drained upland soils with a brown or red fine sandy loam or sandy clay loam surfaces. The subsoils are dark red clay. These soils have a moderately high fertility level and are the best upland soils found in the county. The Nacogdoches soils are adapted to most all crops grown in the county. These soils occupy a narrow strip in the northeastern part of the county running from Union southeast toward Chunky. Although the acreage in the county is not large they are important to the agriculture of the county. These soils are acid in reaction.

Negreet Series

The Negreet Series includes shallow soils in the prairie that have developed from shelly-marl. These soils have a black surface that is usually high in organic matter. The surfaces and subsoils are clay-textures and alkaline in reaction. These soils occur in small areas that are scattered throughout the prairie section of the county. They are not important to the agriculture of the county and are devoted primarily to grass.

Ochlockonee Series

The Ochlockonee Series includes the well drained grayish-brown sandy soils on stream flood plains. These are the best soils found in the bottoms of the county. They have a moderately high fertility level and are well adapted to all row crop. These soils occupy the highest elevation in the bottoms. The acreage of these soils is very small but they are important to the agriculture of a farm on which they are found. These soils are strongly acid throughout the profile and adapted to all general crops.

Ora Series

The Ora Series includes moderately well drained upland soils with grayish brown sandy surface. They have yellowish-red friable sandy clay subsoils below which is found a weakly cemented pan. These soils have developed from thick beds of acid sandy clay loam in which there may be layers of sand, sandy clay, and loamy sand. These soils are widely distributed throughout the county and are used extensively. The smoother slopes are used for row crops with steeper slopes being devoted to grass and trees. They are important to the agriculture of the county. The relief ranges from very gently sloping to sloping. The Ora soils are acid in reaction.

Prentiss Series

The Prentiss Series includes the moderately well drained gray sandy soils on the stream terraces. These soils are derived from materials washed from the Ora, Ruston, Shubuta, and Savannah soils. The subsoils are brownish-yellow in color and sandy clay loam in texture. There is a pan in lower part of the subsoil that has fine sandy loam texture. The Prentiss soils are the dominant type found on stream terraces. They are fairly well distributed throughout the county. They occur on slopes ranging from very gently sloping to sloping. These soils are acid in reaction and are important and adapted for the general crops grown in the county.

Ruston Series

The Ruston Series includes the deep well drained upland soils that have developed from thick beds of sandy clay loams in which there may be layers of sand, sandy clay, and loamy sands. These soils have pale brown or gray sandy surfaces and yellowish-red sandy clay loam subsoils. They occur on level to moderately steep slopes and are found throughout the county. The soils are moderately fertile and are well adapted to most crops common to the county. The soils of the Ruston Series are the best upland soils found in the county and are important to the agriculture of the county. They are acid in reaction.

Savannah Series

The Savannah Series includes the imperfectly drained upland soils with gray or brownish-gray sandy surfaces. The subsoils are brownish-yellow sandy clay loams. The Savannah soils have formed from unconsolidated beds of acid sands, sandy loams, and sandy clays. The soils are low in organic matter and have a moderately well developed structure. These soils have a fairly wide distribution within the county and are important to the agriculture since they are adapted for most crops of the county. They are found in association with the Ora, Ruston, Shubuta soils, and are acid in reaction.

Sawyer Series

The Sawyer Series consists of imperfectly drained acid soils developed from clays and sandy clays. They have gray sandy surfaces and brownish-yellow sandy clay subsoils. These soils are found adjacent to the Prairie Area. The acreage is small and they are not too important to the agriculture of the county. Most of these soils are suited for grass and trees and are acid in reaction.

Shubuta Series

The Shubuta Series includes the moderately well-drained, upland soils that have developed from thin-bedded clays, sandy clays, and clay shale. They have gray or yellowish-brown sandy surfaces and brown or red sandy clay subsoils. They occur on very gently sloping to moderately steep slopes. They are found in association with Ruston, Ora, Savannah and Boswell soils. The acreage of these soils is extensive, are found throughout the county, and adapted for row crops and trees. They are low in organic matter, moderately fertile and acid in reaction.

Stough Series

The Stough Series includes somewhat poorly drained acid sandy soils on stream terraces. They have gray surfaces and pale brown fine sandy clay loam subsoils. These soils have formed from materials that have washed from such soils as Ruston, Ora, Savannah and Shubuta. The soils are low in organic matter, have low fertility level, and are acid in reaction. Due to these conditions they are usually a poor risk for row crops, but are adapted to pastures, hays and some corn.

Sumter Series

The Sumter Series includes soils of the Prairie that have formed from chalk and marl. They have gray calcareous clay surfaces and yellow clay subsoils. These soils occur in small areas and the acreage is not very large. These soils are used chiefly for grass and are not important to the agriculture of the county.

Tilden Series

The Tilden Series includes the moderately well drained soils on stream terraces. They have developed from materials that have washed from such soils as Ruston, Ora, Savannah, Shubuta, and Nacogdoches. They have gray or grayish-brown sandy surfaces and brown or reddish-brown sandy clay subsoils. These soils usually are found on more sloping areas than the Prentiss and Stough. The acreage is not large but where the soils occur they are important to the agriculture of the county.

Una Series

The Una Series includes the poorly drained acid alluvial soils of the Prairie. These soils have formed from materials washed from the Eutaw, Vaiden, Mayhew, and Sawyer soils. These soils have gray clay surfaces. They occur on small drains and the acreage in the county is small. They are not important to the agriculture of the county and are suited for hardwood timber.

Vaiden Series

The Vaiden Series includes the somewhat poorly drained heavy clay soils in the Prairie. These soils have formed from thin beds (less than four feet) of clays over marl or chalk. They have gray surfaces and brownish-yellow mottled subsoils. These soils are known locally as "Post Oak Prairie Soils". These soils are low in organic matter and have a low fertility level. Due to these characteristics and being poorly drained they are poor risk for row crops. The best uses are grasses and trees.

Soil Types of Newton County

Bottoms

Bibb soils
Chastain soils
Catalpa clay
Houlka clay
Iuka fine sandy loam
Johnston loam
Mantachie soils
Ochlockonee fine sandy loam
Una clay

Terraces

Cahaba very fine sandy loam
Independence loamy fine sand
Myatt very fine sandy loam
Prentiss very fine sandy loam
Stough very fine sandy loam
Tilden very fine sandy loam

Uplands

Boswell fine sandy loam
Boswell sandy clay loam
Cuthbert fine sandy loam
Eustis loamy sand
Eutaw clay
Lauderdale stony fine sandy loam
Ruston fine sandy loam
Savannah fine sandy loam
Sawyer fine sandy loam
Shubuta fine sandy loam
Lauderdale-Boswell soils
Mayhew sandy clay loam
Nacogdoches fine sandy loam
Nacogdoches sandy clay loam
Negreet clay
Ora fine sandy loam
Shubuta sandy clay loam
Sumter clay
Vaiden clay

Appendix

Additional Information on Newton County

More than 70 percent of the land area of Newton County is used for agriculture. The rest, largely because of low fertility, unfavorable moisture condition, extreme slopes, and severe erosion, consists principally of forest. Only 38 percent of the acreage in farms, however, is cropped. Among these cotton, corn, soybeans and truck crops are important. Livestock has become important in recent years and considerable acreage is now devoted to pasture, hay and forage crops. Grade A dairies, which are numerous in the county, provide considerable farm income. Cotton, dairy products and pine timber account for a large part of the farm income. Most livestock products are home consumed and marketed locally.

Soil Material

Newton County is a part of the Gulf Coastal Plain Region and is locally known as the "Sand Clay Hills," and the Jackson Prairie (Central Prairie). The geologic formations of the Sand Clay Hills includes the Wilcox group and Tallahatta Sandstone formation known as the Buhrstone. The Wilcox formation is composed of marine heavy clays, sandy clays, and sands which give rise to bright colored red and yellow soils. The Tallahatta formation is composed of soft claystone, sandstone, quartzite, and sands. A perpendicular exposure of this material resembles the walls of an old stone building with its laminated layers of broken claystone and interbedded layers of clay and sand.

The Jackson formation (Central Prairie) is composed of marl and clays. It is similar to the Selma Chalk formation.

There is considerable variation in the surface relief of the county. The flood plains are nearly level and the stream terraces are level to sloping. The uplands, comprising the greater part of the county, range from level to moderately steep. The steeper areas occur in the Northeastern part of the county along the Lauderdale County line, west of Decatur, and north of Conehatta.

How Soils Are Developed

Soil is the product of the forces of weathering and soil development acting on parent soil material deposited or accumlated by geologic agencies. The characteristics of soil at any given point depends on (1) the physical, chemical and mineralogical composition of the parent material; (2) the climate under which the soil material has accumulated and has existed since accumulation; (3) the plant and animal life on and in the soil; (4) the relief or lay of the land; and (5) the length of time and the forces of development that have acted on the material.

Climate and vegetation are active factors of soil formation. They exert their influence on the parent material and change it from a mass of inert material to a body that has definite parts. The effects of climate and vegetation on the parent material are guided, or limited, to varying degrees by the modifying influence of relief as it affects conditions such as drainage, quantity of water it percolates through the soil, rate of erosion, and vegetation growing on the soil. The nature of the parent material itself also guides the course of action that results from the forces of climate and vegetation. Finally, time is involved in the changes that take place, and age becomes a factor of soil formation, as it reflects the degree of development of the soil into a body that is in equilibrium with its environment. The degree of such development depends not only on time, but also on rate of action of the forces of climate and vegetation as that rate is influenced by the factors of relief and parent material.

The parent material of soils in the Sandy Coastal Plain Section is sands, clays, and sandy clays. The Prairie section of the county has parent material mainly of soft limestone with some quartz sand and glouconitic clays.

Soils must be examined to a depth of 36 inches or more for proper classification. Often two soils have identical surface layers, but differ widely in the subsoil, and, therefore, have different land uses and agricultural values. The subsoil regulates such important things as: the rate and amount of water that can pass through the soil, the amount of air in the soil, water holding capacity, depth that taproots may go in search of water; the extent that feeder roots may search beneath the surface layer for plant food; the amount of soil leaching; and the soil temperature which greatly affects the developing root systems and growth of the plants·

Methods Used in Soil Survey of Newton County

Soil scientists walked over each field in the county and examined the soils frequently by boring holes with an auger or digging with a spade. They also studied exposures of soils in banks, roadcuts, and pits.

Each boring or hole revealed a series of distinct layers. These layers are called **horizons** and collectively form the soil **profile.** The A horizon consists of the surface soil and subsurface soil; the B horizon, the subsoil; and the C horizon, the parent material from which the soil is formed. Arrangements and thickness of the different layers or horizons help to characterize the soil.

Properties such as texture and color usually vary in the different layers, or horizons, of the soil. The surface layer is usually gray or brownish gray and the subsoil darker in color. Mottling is usually greater in the lower layers than the surface. The following characteristics were considered:

Texture—The content of clay, silt and sand in a soil determines its texture. Texture is first judged by the feel and to some extent by the appearance of the soil and may be later checked mechanically by laboratory analysis. The finest particles in the soil are clay. Individual clay particles are so fine that they can scarcely be seen with a microscope. Soils that consist principally of clay are usually sticky when wet and rather hard when dry. Water moves slowly through clay soils; they retain moisture and plant nutrients well.

Medium-sized particles, large enough to be seen with a microscope, are called silt. Silty soils are smooth and velvety; they are not so hard when dry nor so sticky when wet as clay soils.

The largest particles in the soil are called sand. Individual sand particles can be seen with the naked eye. Water moves rapidly through sandy soils and they retain relatively little water for plants. For this reason, extremely sandy soils are droughty.

Structure—This is the arrangement of the individual soil particles into aggregates. When dry some soils are loose and crumbly; others can be broken down into blocklike clods; and still others have small platelike pieces. The structure of a soil determines how air, water, and plant roots penetrate it.

Color—Other soil properties are indicated by color. Dark colored soils are usually high in organic matter and, other things being equal, are more productive and more easily tilled than light-colored ones. Color also indicates drainage. In Newton County well-drained soils are usually red or brown; poorly drained soils have subsoils that are gray or are mottled with gray or yellowish brown.

Drainage—Wetness of an area, color of the soil and its position in the landscape are factors that indicate drainage. In Newton County there is a wide variation in drainage, which is a major cause of the differences in crop suitability. The terms used to indicate drainage are excessively drained, well drained, moderately well drained, poorly drained, and very poorly drained.

Chemical properties — Acidity and other chemical properties indicate the way in which the soils were formed and how productive they may be.

Topography or lay of the land—Definite combinations of soil profile characteristics are usually associated with topography. Certain soils are always found on undulating, gently undulating, and steep slopes; others are always on level topography and in depressions. Different combinations of these soil characteristics are the basis for separating one soil from another. In determining the kinds of soils to be mapped in the county, combinations of soil properties important to crop production and soil management were emphasized. The kinds of soil were classified into soil series, types, phases and complexes.

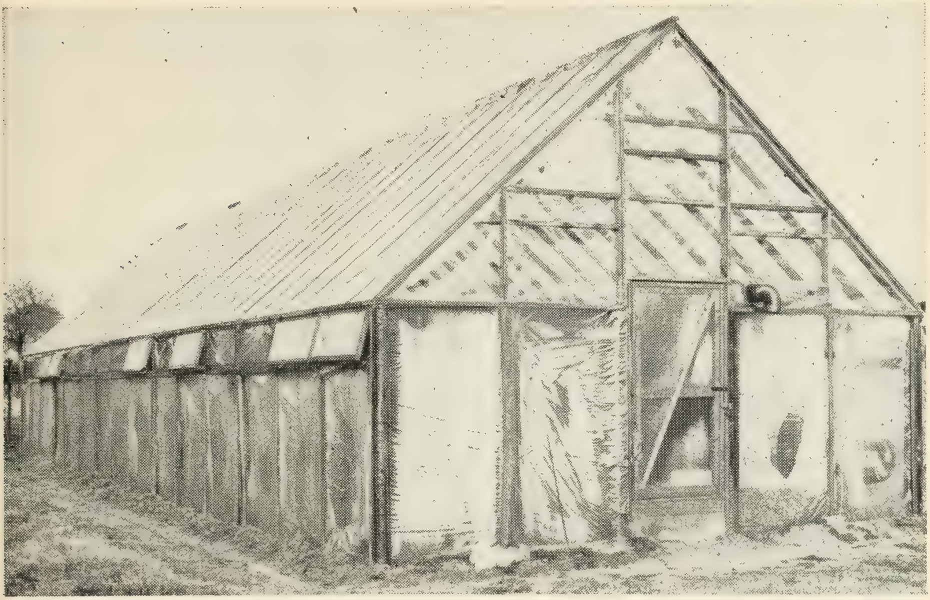
A soil series is a group of soils that, except for the texture of the surface soil, have similar characteristics within the soil profile. All soils of the same series have developed from the same kind of parent material. Variations in slope or in other features external to the soil profile are permitted so long as the variations do not affect the profile characteristics. Each series is given a name, which is usually taken from the locality where the series was first recognized.

A soil type—A soil type is a subdivision of a soil series. The texture of the surface soil determines the number of soil types in a series. There may be one or more types in a series, because soil types are differentiated from one another on the basis of texture of the surface soil. Thus Nacogdoches fine sandy loam and Nacogdoches sandy clay loam are soil types within the Nocogdoches series.

Variations within the soil type—chiefly in such external characteristics as relief, stoniness, accelerated erosion, or depth of surface soil—are designated as **soil phases.** Nacogdoches fine sandy loam eroded undulating phase, and Nacogdoches fine sandy loam eroded gently undulating phase are examples of phases originating from slope conditions in Newton County.

At times, different kinds of soils are so intricately associated that it is impossible to map them separately. Such areas are called **complexes,** and the complexes are named for the soils they contain. Eutaw-Vaiden clays, level phase, is one of the complexes mapped in Newton County.

BULLETIN 563 AUGUST 1958



Building and Using a Plastic Greenhouse

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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A portion of a Tuckcross V plant in the plastic greenhouse showing fruiting of the 7th, 8th and 9th clusters on Februray 26, 1958. Four fruits had been harvested from the lower cluster when this photograph was made. Leaves were removed from the plant to expose the fruit for photographing.

BUILDING AND USING A PLASTIC GREENHOUSE

E. L. MOORE and KERMIT R. RAY[1]

The high cost of building materials has discouraged many farmers and hobbyists from constructing conventional type greenhouses for growing plants during the cool seasons of the year. Greenhouses may now be constructed at a relatively low initial cost. They are framed with wood and covered with plastic. The construction cost is about one-tenth that of a steel-framed glass house.

In January of 1957 an experimental plastic greenhouse was built 18 feet wide and 60 feet long at State College to explore problems of construction, design, and operation. The house, complete with a heating system and exhaust fan, cost slightly less than $700. In private construction this cost may be reduced in many ways. It is estimated that $200 per year will pay for replacing the plastic and provide fuel for heating the house after the first year.

The first part of this article deals with construction and design, and is a revision of Circular 210. It is intended to serve as a guide to those interested in building plastic greenhouses. The second part deals with the operation of the house, cultural practices and the results of two tomato crops.

Construction and Design

The house was 18 feet wide and 60 feet long. The length of the structure may be easily varied to suit individual requirements. Round posts 5 inches in diameter and 8 feet long were sunk 2 feet in the ground. They were spaced 12 feet apart along the two sides. Two half-round posts 4 inches in diameter and 6 feet long were equally spaced between the round posts. They were sunk 1½ feet in the ground. The placement of the round and half-round posts within one 12-foot section along one side and near a corner of the house is shown in Figure 1. At the ends of the house, two round posts were spaced 3½ feet apart for a door near the center. One half-round post was placed midway between a door and a corner post as shown in Figure 2. All posts were previously pressure treated with a preservative material ("Penta") and the underground portions were embedded in concrete.

The house framing was constructed of utility grade, dressed western fir. Other kinds of lumber can be used with equal satisfaction, and should be selected on the basis of price and durability. The plates, ventilator sills, studs, and door framings were made of 2 by 4 inch lumber. The plates were nailed flush with the outside and to the top of the round posts making the eaves 6 feet high. Eaves 5 feet high would be equally satisfactory and in some cases 4-foot eaves would be acceptable. The side ventilator sills were nailed on top of the half-round posts and to the sides of two round posts leaving 18-inch ventilators along each side of the building.

The rafters were 2 by 3 inch material 12 feet long and were cut on an 11 by 12 slope giving a roof pitch of 42.5 degrees and were spaced 24 inches apart on centers. They must be spaced to fit the width of the plastic, but spacings less than 21 inches or greater than 36 inches should be avoided. A 24-inch spacing was satisfactory for applying plastic sheets 54 inches wide. It allowed ample material for pulling wrinkles out of the sheets and for lapping at the edges.

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[1] Dr. Moore is associate horticulturist, Experiment Station, and Mr. Ray is architect for the Extension Service.

One end of the rafters was nailed directly to the plate at the eaves and the other to a 2 by 6 inch ridge board at the cap. They were attached to the lower edge of the ridge board so that ridge ventilators could be hinged near the upper edge.

The roof pitch of plastic greenhouses is important. A steep slope was employed to cause the water that condenses on the roof interior to roll down to the sides rather than fall upon the plants below. High moisture conditions on plants favor the development of leaf diseases and increase plant injury from excessive accumulation of gases. A second reason for a steep slope was to improve circulation of hot air uniformly throughout the house. With heating pipes located along the outer edges, the hot air rises, follows the roof to the ridge and then drops near the center of the house; thus, forming a circular air movement. When the ceilings are more nearly flat the air forms a temperature strata; near the ceiling it is hot, and near the ground it is cold. A steep roof also sheds ice well in the event of a sleet storm.

In contrast to glass greenhouses which require rigid roofs, no purlin is necessary in plastic greenhouses. One should keep in mind that excessive amounts of framing in the roof shade out light greatly needed in the house. If purlins are used, they should be of a small material (1 by 2 inches) and the number of pieces kept to a minimum. The State College house was braced with a 9-guage wire attached near the top of each round post, run underneath and on a diagonal with the rafters, and fastened to the ridge board. Two wires crisscrossed each 12-foot section of the roof and were made tight by means of turnbuckles.

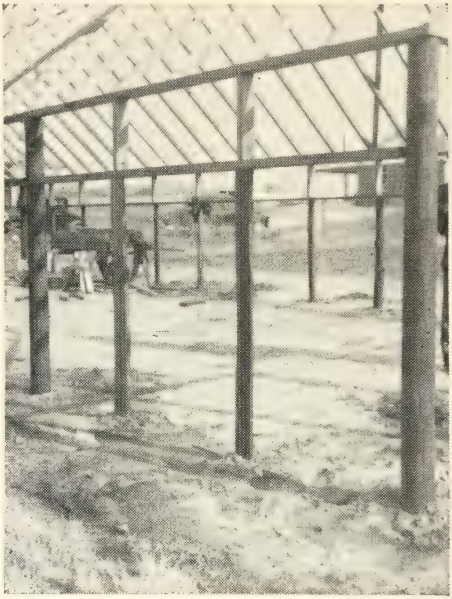

Figure 1. View of one side near a corner showing the placement of round posts, half-round posts, ventilator studs, sills and plates of a plastic greenhouse. Ventilators are 18 by 45 inches.

Frames for all ventilator shutters were constructed of 2 by 2 inch lumber, held together with corrugated fasteners and nails. Those for the sides were made small (18 by 45 inches) and a series of them extended the entire length of the building. They were made small so that the amount of ventilation supplied to this experimental house could be easily controlled and the amount needed more accurately determined. They were hinged to the plate. The ridge ventilator shutters were 1½ by 12 feet and were hinged to the top of the ridge board.

Props for the shutters were made of 3/4 by 3/4 inch lumber. The side shutter props were 24 inches long. Holes large enough for an eight penny common nail to slip through freely were drilled at 3-inch intervals from one end of the props to the other. An eyelet screw was then screwed into one end of the prop and another into the lower side of the shutter. The eyelet in the prop was then interlocked with the one in the shutter, forming a flexible joint. A hole was drilled into the ventilator sill adjacent to the eyelet screw in the shutter. By placing a nail through the holes in the sill, the shutters could be raised to any desired height. These props hold the shutters rigidly in place even in moderately strong winds. The shutters were held in a closed position by screen hooks and eyes. Ventilator stops of 3/4 by 3/4 inch material sealed the cracks around the shutters.

Adequate ventilation is one key to the successful operation of plastic greenhouses. It has been found, however, that ridge ventilators were not necessary when sufficient side or end ventilators were provided. Elimination of the ridge ventilators simplifies construction and reduces the cost of the house.

In the construction of a commercial plastic greenhouse large ventilators along each side should be adequate. Since plastic houses are generally tighter than glass houses, consideration should be given to the construction of removable panels for the sides. They could be either hinged or completely removable.

Forced air ventilation should also be considered. This may be accomplished simply by the use of exhaust fans mounted in one end of the house, and ventilators in the other so that the air is pulled through the entire length of the building. If forced air ventilation is used, neither ridge nor side ventilators are necessary and the construction of the house is simplified.

A 36-inch exhaust fan was mounted in the north end of the house. It was adequate for satisfactory ventilation under most weather conditions. The difficulty has been that the volume of air displaced cannot be easily changed. Two smaller fans (18 or 24 inches) or a large fan with several speeds would be more desirable. Frequently only a small volume of air need be exhausted, but on the other hand, there are times when large volumes of air must be removed.

All lumber was treated with either Cuprinol or Cop-R-Tox. All wood preservatives injure plants, but the above two are relatively safe with certain precautions. First, treat as much of the lumber as possible away from the greenhouse site. Second, allow the treated lumber to dry for several days. And, third, avoid spilling any preservative on the house site.

Covering Material

Several companies make plastic for covering greenhouses, hotbeds and other plant growing structures. There are two general types of plastic available. One type, polyethylene plastic, lasts one season. The intense ultra-violet rays of the summer sun deteriorate it within six weeks. Rays of the fall and winter sun have no noticeable effect upon it. The polyethylene installed on the house at State College during January of 1957 began to break down about May 1, 1957. That installed on September 20, 1957, began to break down during late April of 1958.

This translucent material transmits enough light for satisfactory plant growth.[2] It is available in a variety of widths up to 40 feet and the thicknesses most commonly used are 2, 3 or 4 mils (.002, .003 or .004 inches).

A second type, sold under a trade name, is supposed to last several years. Some of these "permanent" materials have been predicted to hold up for as long as 8 to 10 years, after which they discolor slightly. This prediction was based on exposures to stepped-up artificial light rays equal to that of the sun for 8 to 10 years. None of the plastics have been exposed to natural weathering for that length of time, although such tests are currently being made.

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[2] The polyethylene plastic used on the house at State College was supplied by the Bakelite Corporation, one of the larger manufacturers of polyethylene resins.

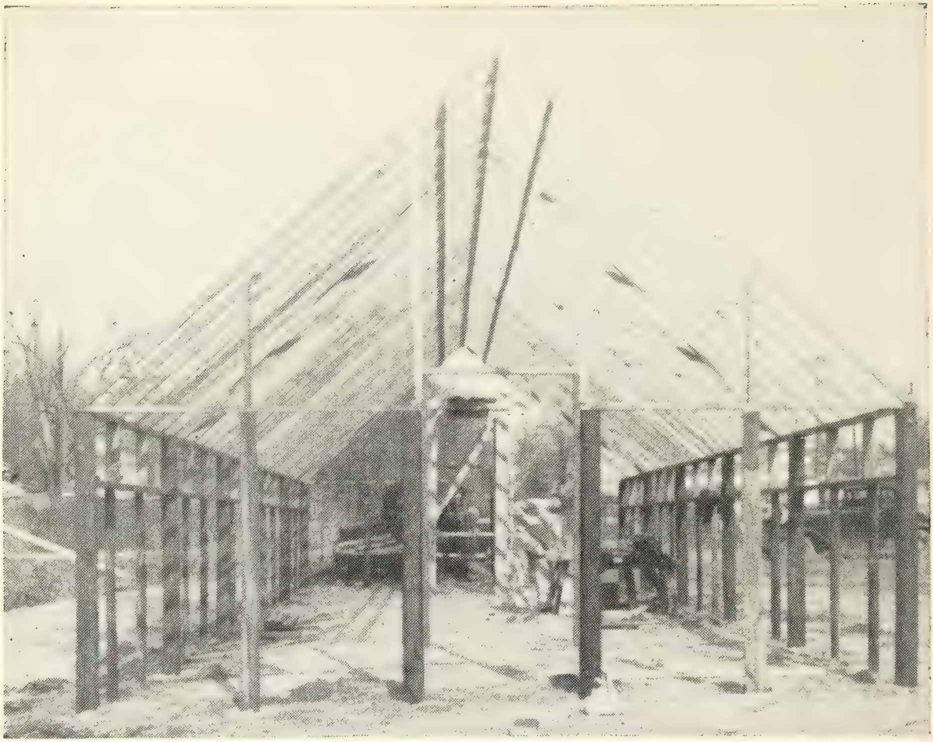

Figure 2. End view of plastic greenhouse framing.

Preliminary reports from various sections of the United States as well as work of the Mississippi Agricultural Experiment Station, indicate that some of the "permanent" plastics are not holding up as well as laboratory reports indicated they would. On the other hand, others appear satisfactory after two or more years testing. Before testing these materials, the grower should investigate their durability by contacting his agricultural experiment station.

It is suggested that polyethylene be used as a covering for plastic greenhouses until the permanent types have been adequately tested under field conditions. Polyethylene is available at many local hardware and building supply houses. It is packed in rolls similar to wrapping paper.

Number of Layers

There are advantages and disadvantages in covering a house with two layers of plastic. One advantage is the conservation of heat. It is generally known that two layers of a material separated by a dead air space is a good insulator. In plastic greenhouses, two layers have been calculated to conserve up to 40 percent of the heat. In the State College house a second layer conserved less than 20 percent.

A second advantage of two layers is the reduction in moisture condensation on the ceiling and sides. Since the warm moist air in the greenhouse is in contact with a warmer surface than it would be when only one layer is used there is less condensation inside the house. In the State College house, as well as others observed in Mississippi, moisture condensed between the two layers, and will be discussed in connection with the disadvantages.

A third advantage of the two layers is the protection provided if the outside layer is damaged. Damage may occur from hail, from strong winds, or as a result of faulty installation of the plastic. In general, plastics are reported to incur less damage in hail storms than glass.

One of the main disadvantages of two layers is the reduction of light transmission. The thickness of the film had little effect on the amount of light transmitted but the addition of a second layer reduced it considerably. Light intensity readings were made when the sun was almost obscured by clouds (5,000 foot candles) and when the sun was shining through a clear sky (12,000 foot candles). The percent of light transmitted through plastic varied very little under this range of conditions. When condensation was negligible, one layer of 2-mil polyethylene transmitted 80 to 85 percent of the light which compared favorably with glass. Two layers of the same material transmitted about 65 percent. Light transmission through two layers of 2-mil polyethylene was less than 50 percent when moisture condensation was present.

Two layers did not transmit adequate light for satisfactory plant growth or fruit set of tomatoes during prolonged periods of cloudy weather. When the outside light intensity dropped below 5,000 foot candles for as long as four days, tomato flowers began to drop from the plants. Experiments reported previously have shown that the average minimum light intensity required for fruit set of tomatoes is about 3,000 foot candles.

A second disadvantage is the difficulty of installing the inside layer. By using wide material the outside layer may be installed relatively easy with one sheet. In contrast the inside layer is not easily installed as one large sheet. In some cases plants should be established and growing in the house before the cover is applied and the danger of breaking them further complicates the installation of the inside layer.

A third disadvantage is the additional costs. Not only the cost of the plastic is involved but also the extra labor, batten strips, nails and scaffolding.

Covering The House

The house should be covered no earlier than September 15 to October 1, in central and north Mississippi. By this time of year the intensity of the sun has subdued, the air temperature has cooled and the plastic will stand up through the winter.

The ends of the house above the plate should be covered first. This allows the plastic to be pulled over the two end rafters and temporarily tacked to the inside of a rafter. When the roof is installed it overlaps the end covering, giving a tight seal. The plastic is readily rolled out near the building and the appropriate lengths cut to fit the ends of the structure. It is then fastened to the framing by means of batten strips and small nails. Stapling machines are available for stapling the strips down. Their main advantage is to speed the installation.

Although polyethylene is reasonably tough, certain precautions should be taken during installation. Avoid rolling the plastic over sharp objects such as rocks or punturing it with sharp finger nails. In fact, crumpling the film in the hands or pulling it with the fingers in a rough manner weakens it and may cause subsequent damage. Also, avoid stretching the film too tight on the house. During warm weather the material should sag about an inch between rafters spaced two feet apart. It must be kept in mind that as the weather cools the plastic becomes tighter and will tear during cold weather as shown in Figure 3 if installed too tightly.

The plastic breaks first along the edges of the rafters, and the size of the batten strips influence the severity of breakage. There was no breakage where the batten strips were ½ inch wider than the rafters. On the other hand, breakage occurred where the strips were narrower than the rafters. Apparently the wider strips shaded the plastic and the rafter, reduced the heat absorbed and reduced the amount of breakage. Batten strips 3/8 by 2 1/2 inches were satisfactory on 2 by 3 inch rafters. They may be of either rough or dressed lumber. The nails or staples should be spaced about 12 inches apart along the batten strips.

The film for the roof may be cut on the ground or rolled directly onto the roof. The latter method is most desirable if a strong wind is blowing. With either method an individual sheet should be used for each side rather than one large sheet to cover both sides at the same time.

The plastic should lap about 8 to 12 inches at the ridge. When the first side was being covered the upper two feet of the batten strips were not nailed fast. Then when the second side was covered the plastic was pulled over the ridge, placed under these batten strips and then nailed fast. A batten strip nailed to the ridge board and running lengthwise the house gave a tight seal at the ridge. The plastic was also battened to the eaves. The ventilator shutters may be covered at any time. They are conveniently covered at a work table before being attached to the house.

Heating

A satisfactory heating system is essential. Make-shift heaters lead to more trouble than any other item in a plastic greenhouse. Dry heat is highly desirable and should be circulated throughout the house. A central heating system with hot water or steam pipes leading through a house is the most satisfactory,

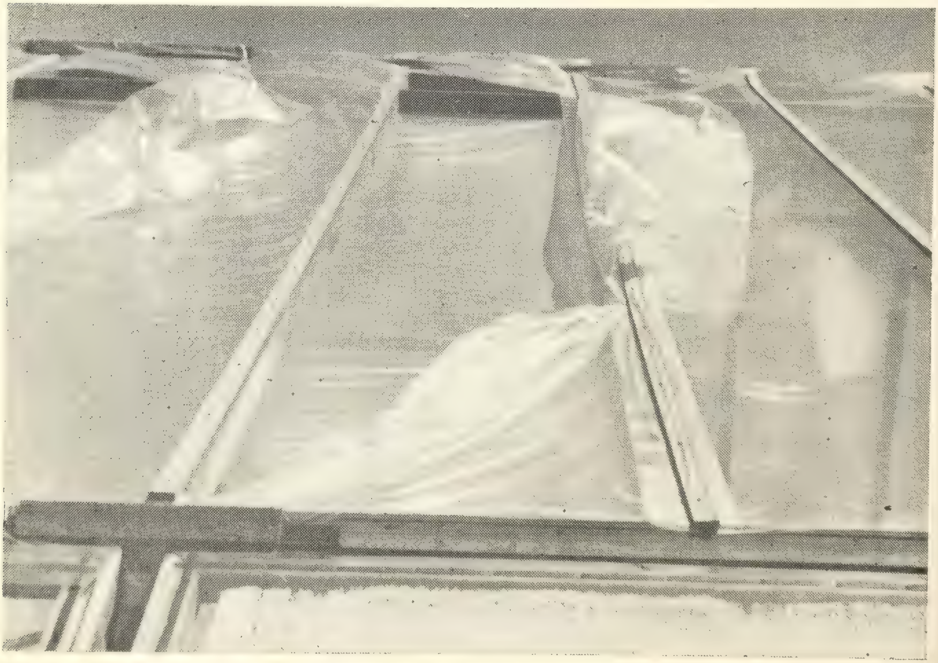

Figure 3. Polyethylene torn due to faulty installation. This film was pulled too tight when applied. As the weather cooled, it became tighter and broke at the rafters. An inch sag during warm weather between 2 foot rafter spacings is desirable.

but on a small scale operation may not be practical.

Electricity affords an excellent type of heat and should be considered where the cost is less than one cent per kilowatt hour. One disadvantage of electric heat is a power failure.

Small gas heaters are commonly used in plastic greenhouses. They may be either natural or LP gas types. With either type, vented heaters are preferred especially when fruiting crops such as tomatoes are to be grown. Vented heaters remove the fumes from the burning gas and also remove the large amounts of water released. When gas burns, carbon dioxide and water vapors are given off. Plants use both, but excessive amounts of either are harmful. Vented heaters also remove the non-burned gas. The average combustion efficiency of most gas heaters is 70 percent. If non-burned gases are not removed from the house, they injure plants, particularly tomatoes.

The amount of heat required during average winter conditions in Mississippi depends on the size of the house and its tightness. A well constructed house 12 by 18 feet requires roughly 32,000 B. T. U. of heat. The 18 by 60 foot house at State College was equipped with a thermostatically controlled 160,000 B. T. U. heater. It was located in the north end of the house which is usually the coldest part. Common stove pipes were attached to the heater vents and extended around the inside edges of the house. By means of a vacuum blower the fumes were exhausted from the pipes out of the south end of the house.

When the heater was first installed only a single run of pipe connected it to the exhaust blower. The north part of the house heated up too much and the south end remained too cool. In addition, too much heat was lost through the exhaust. It was found that about 350 linear feet of 6-inch stove pipe was necessary to adequately radiate the heat and distribute it uniformly with a minimum loss through the exhaust. The necessary amount of pipe was installed by placing a triple stack in the south half of the house. This arrangement kept a uniform temperature throughout the house. The variation in temperature from one end of the house to the other was never greater than four degrees. From either side to the center the greatest variation observed at a height of five feet was two degrees.

The main gas line from the meter (or tank) to the house must be large enough to accomodate the heaters in the house. Most gas company representatives will gladly assist in determining the correct pipe size.

Greenhouse Operation for Tomato Production

Successful production of any greenhouse crop depends on a proper control of the light, temperature, moisture and the nutrient supply best suited for the crop. Many diseases and insects attack tomatoes and may be a problem in the plastic greenhouse. Recommendations for their control may be found in Mississippi Agricultural Experiment Station Bulletin 453, "Vegetable Diseases and Their Control in Mississippi," and in Extension Service Leaflet 167, "Kill Garden Bugs."

In general, artificial light is not used in commercial tomato production. Every practical means should be employed to get as much sunlight as possible to the plants during the winter months. If the light intensity falls below 2,000 foot candles for four consecutive days, many of the flower buds drop regardless of how well other factors are controlled.

Greenhouse temperatures may be controlled by proper ventilation and adequate heat. While the crop is growing, the temperature during the night and on cloudy days should be held between 60 and 68 degrees F. On clear days it should be held between 70 and 85 degrees. The flower buds develop normally and the fruit produced are smooth under these temperature conditions. The flowers drop and the fruit that develop are poorly shaped when the plants are grown at night temperature either below 58 or abve 70. If adverse temperatures occasionally occur for only an hour or two during a day, little damage is done. Severe damage results after the plants are periodically exposed for three or four consecutive days to such temperature. Heaters equipped with thermostats are good for maintaining precise temperatures.

The greenhouse should be ventilated as often and as long as necessary to cool the house, remove moist air and bring in fresh air. No set rules for all weather conditions can be laid down. Generally, ventilators should be raised on clear days after temperature inside the house reaches 70 degrees. They may be closed when afternoon temperature in the house drops to 75. During cold, cloudy weather it is desirable to ventilate the house at least once each day to remove the moist air. Moisture evaporating from the soil and transpiring from the plants builds up the humidity in the house. Humidity must be kept as low as practical to reduce the development of fungus diseases on plants, and prevent gas injuries.

The amount of water needed for growing plants in a plastic greenhouse and the frequency of applications depend on the soil structure and the amount of sunlight. Some soils are poorly drained and should be avoided where possible. Otherwise, they should be tile drained. Ditches 12 to 18 inches deep around the outside of the house may provide adequate drainage of soils that have moderately poor drainage. The plant beds must be watered often enough to maintain ideal soil moisture conditions. Under no condition should the plants be allowed to wilt, nor should the soil be "water-logged". In general, weekly waterings are satisfactory, but in some cases more or less frequent applications are needed.

The nutrient supply must be ample for moderate vegetative growth, flower bud formation and fruit development. If the nutrients, particularly nitrogen, are in excess, the plants grow vegetatively and may not fruit well. On the other hand, if the nutrients are low, the plants make insufficient growth to support a satisfactory crop. Most Mississippi hill soils require a complete fertilizer. About 25 pounds of 5-10-5 or the equivalent are needed per 1,000 square feet of greenhouse bed. If the plant leaves lack a moderately green color or if the stems are not stocky, an application of nitrogen fertilizer may be needed. Frequent, light, nitrogen applications are preferred to a single heavy one. Two to four pounds of nitrogen fertilizer (ammonium nitrate or nitrate of soda) per 1,000 square feet are adequate. Barnyard manure improves the physical conditions of the soil and adds nutrients. It may be used if it is well rotted and thoroughly incorporated into the soil. A layer about two inches deep and worked well into the soil a few weeks before planting time is satisfactory.

Tomato Pollination

Pollination is necessary for proper fruit set. In the field or garden, the wind shakes the flowers and scatters the pollen over the stigmas. In greenhouse tomato production some artificial method of vibrating the flowers is necessary. One method is to gently strike the base of the flower clusters with a short piece of flexible tubing. It is very effective but time consuming. Another method is to strike each overhead wire with a stake. This vibrates several plants at one time and does a fair job of pollination. A third, and the most satisfactory method, is the use of an electric vibrator that operates on an ordinary dry cell battery. It is simple to operate. A rubberized wire loop extending from the vibrator is held at the base of the flower cluster. When the electric switch is turned on, the loop vibrates the flowers causing the pollen grains to scatter over the stigmas.

Pollination must be done when the flowers are fully open. Since all the flowers of a cluster are not open at the same time each cluster should be vibrated on three to five successive days. The operation may be done at any time during the day that the flowers are dry enough for the pollen to scatter. The best time is usually between 9 A. M. and 3 P. M.

Fruit-Setting Chemicals

A good set of fruit is difficult to obtain by natural pollination methods during prolonged cold or cloudy weather. Fruit-setting chemicals known as hormones may be used to improve fruit set. Two chemical sprays that have been adequately tested by the Mississippi Agricultural Experiment Station and found to be satisfactory are Sure-Set (para-chlorophenoxyacetic acid) and Blossom-Set (beta-naphthoxyacetic acid).

These materials are sprayed on the individual flower clusters when the flowers are open. Care must be taken not to direct the spray at the leaves as the chemicals injure the foliage. Under ideal tomato growing conditions there is no advantage to using them.

Results From Two Winter Tomato Crops

A preliminary test of tomatoes in a plastic greenhouse was conducted during the late winter and spring of 1957. Five varieties commonly grown as market garden tomatoes were tested. Seedlings with the first flower buds showing were transplanted from 3-inch cups into the plastic greenhouse on February 20. They were spaced 18 by 24 inches apart, pruned to a single stem, and trained to heavy twine suspended from an overhead wire. Nine plants of each variety were planted at random in each of four replicates. The varieties and their average marketable yields in pounds per plant are presented in Table 1. Although the differences in yields among varieties were small, Gulf States Market and Break O'Day produced the highest yields. The first fruit were harvested from these plants April 25. The last harvest was made about June 15, when locally grown field tomatoes began to reach the market.

Table 1. The average marketable yield per plant of five tomato varieties grown in a plastic greenhouse, 1957.[1]

Variety	Yield lbs.
Gulf States Market	6.6
Break O'Day	6.2
Manalucie	5.8
Southland	5.7
Rutgers	5.2

[1] A house 18 x 60 feet provided space for 243 tomato plants.

A detailed test of nine greenhouse forcing tomato hybrids was conducted during the fall and winter of 1957-58. The seed were planted on August 21, 1957. Seedlings were transplanted into 3-inch cups on September 3, and into the plastic greenhouse on September 26. In the greenhouse each hybrid was placed at random in each of three replicates giving a total of 27 plot rows. Each plot contained nine plants making in all 243 plants in the house. They were spaced 18 by 24 inches apart, pruned to one stem and trained to heavy twine suspended from overhead wires.

A layer of well rotted barnyard manure two inches deep was spaded into the greenhouse soil on September 3, wet down and spaded again to a depth of about eight inches on September 10. On September 24, 50 pounds of hydrated lime and 25 pounds of 5-10-5 was broadcast over the 18 by 60 foot area and the soil spaded a third time. The plants were side-dressed with ammonium nitrate at a rate of two pounds per 18 by 60 foot area on November 4, and again on January 27, 1958.

The roof of the house was covered with plastic September 20-25, and the sides on October 15. The heating system was installed on October 14, and the thermostat was set for operation the following day.

The hybrids, their marketable yields and other pertinent data are presented in Table 2. The data show that all hybrids tested which had Tuckers Forcing as a parent produced high yields. Tuckcross V produced 7.3 pounds per plant, the highest average yield in the experiment (Figure 4.) Tuckcross M yielded 6.9 pounds, and Tuckcross O, 6.1 pounds. Waltham Hybrid yielded almost as well. The highest individual plant yield was 15.8 pounds and was produced by a Truckcross O plant.

The fruits of these high yielding hybrids were rated as very attractive. Those of Michigan - Ohio Fl, Tuckers Forcing, Michigan State Forcing, Ohio W R Seven and Globelle were rated as moderately attractive. The fruit carpels of the moderately attractive hybrids tended to be prominent giving a slightly ridged appearance. Information on the average fruit weight, fruit color, dates of first flower and first harvest, and reaction to leaf mold of each hybrid are presented in Table 2.

The average yield per plant was not as large as may be obtained from greenhouse tomatoes. The winter of 1957-58 was much colder than the average at State College and on several days the heating system was inadequate. Several periods of cloudy weather also prevailed for a week or more. These conditions resulted in poor fruit set. In these experiments the only artificial means used to aid pollination was to strike the overhead wire daily with a stake. More effective pollination methods would undoubtedly improve fruit set and increase yields. The productivity of the plants diminished about May 1, due mainly to their age, length and crowded conditions. This indicates that greater yields may be obtained from two tomato crops during a winter season.

Table 2. The average marketable yield, fruit size, fruit color, earliness, and reaction to leaf mold of 9 forcing tomato hybrids grown in a plastic greenhouse, 1957-58.

Hybrid	Yield per plant (Lbs.)	Fruit size (Oz.)	Fruit color	First flowers opened	First fruit harvested	Leaf mold reaction[1]
Tuckcross V	7.3	4.3	Red	Oct. 19	Dec. 20	Resist.
Tuckcross M	6.9	4.8	Red	Oct. 23	Dec. 25	Resist.
Tuckcross O	6.1	4.3	Red	Oct. 19	Dec. 14	Resist.
Waltham	6.0	4.0	Red	Oct. 27	Dec. 25	Resist.
Michigan-Ohio F	5.3	4.6	Pink	Oct. 27	Dec. 30	Suscept.
Tuckers Forcing	4.8	4.6	Red	Oct. 26	Dec. 20	Resist.
Michigan State	4.1	4.6	Red	Oct. 30	Dec. 30	Suscept.
Ohio WR Seven	3.4	4.8	Pink	Oct. 26	Dec. 30	Suscept.
Globelle	2.7	4.2	Pink	Oct. 28	Jan. 2	Resist.

Least difference required for significance among hybrid yields @ .05 is 1.1, @ .01 is 1.91 pounds.

[1] As determined by Dr. W. W. Hare, Plant Pathology Department.

BULLETIN 564 AUGUST 1958

Mississippi Hospitals, 1957

Characteristics and Trends

MISSISSIPPI STATE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

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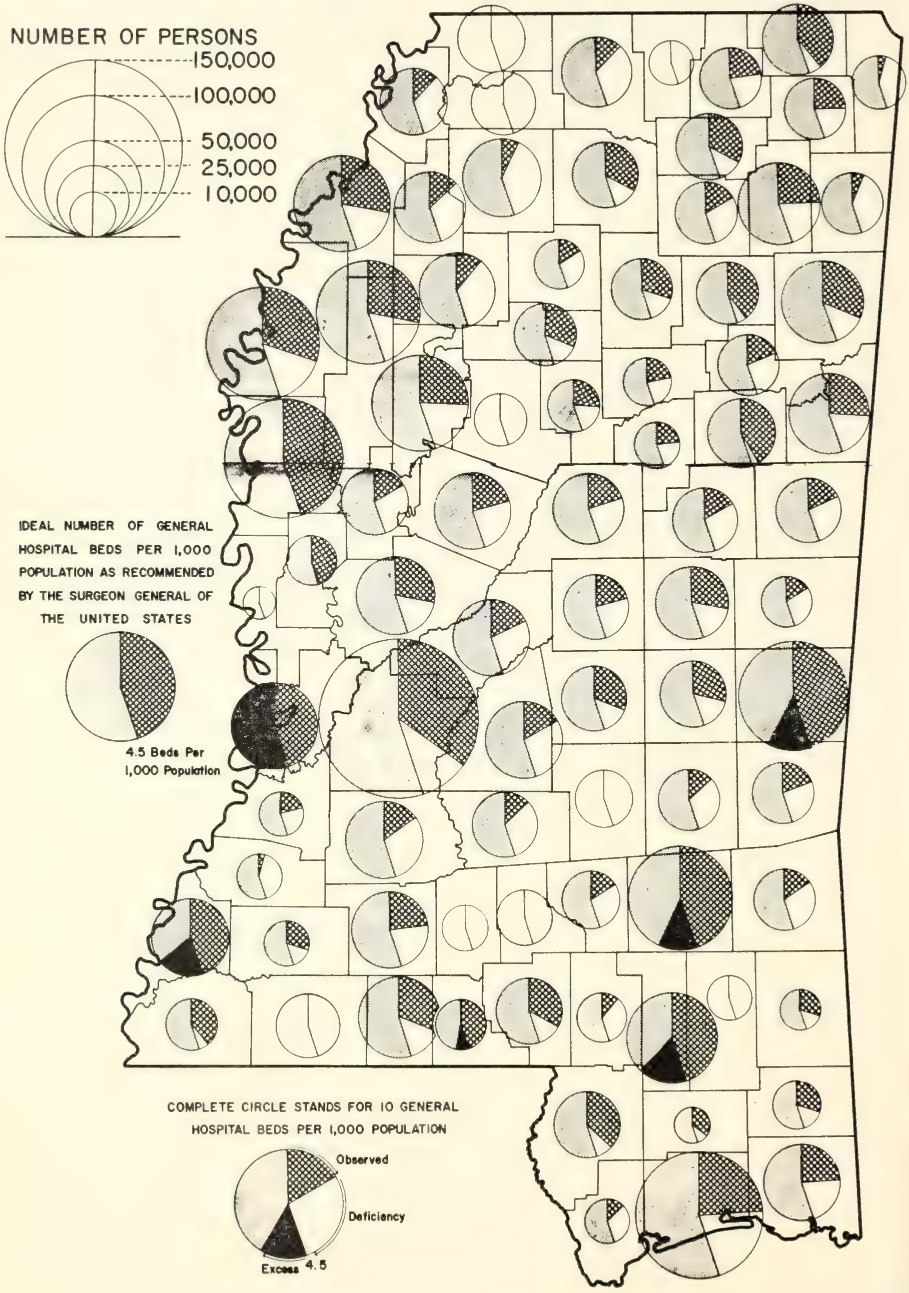
POPULATION, AND NUMBER OF GENERAL HOSPITAL BEDS PER 1,000 POPULATION BY COUNTIES, MISSISSIPPI, 1955


NUMBER OF PERSONS
150,000
100,000
50,000
25,000
10,000
IDEAL NUMBER OF GENERAL HOSPITAL BEDS PER 1,000 POPULATION AS RECOMMENDED BY THE SURGEON GENERAL OF THE UNITED STATES
4.5 Beds Per 1,000 Population
COMPLETE CIRCLE STANDS FOR 10 GENERAL HOSPITAL BEDS PER 1,000 POPULATION
Observed
Deficiency
Excess
4.5

MISSISSIPPI HOSPITALS, 1957 CHARACTERISTICS AND TRENDS[1]

By J. D. V. SAUNDERS and J. H. BRUENING

It is the purpose of this paper to present a statistical description of trends and characteristics of Mississippi hospitals. Trends in the number and the type of ownership of hospitals and of "acceptable" and "non-acceptable" beds are followed by an analysis of the number of hospitals, of hospital beds, and of admissions in terms of hospital bed size. Percent occupancy, cost per patient, number of bassinets, facilities, and births are similarly related to hospital bed size.

Hospital towns or cities in several size categories are examined in the light of the proportion of total hospital beds and admissions they account for and hospital bed size, length of stay and percent occupancy. The final analysis directs attention to beds-per-person ratios in each Mississippi county in terms of recommendations of the U. S. Surgeon General and the Mississippi Commission on Hospital Care.

Number and Type of Hospitals

In Mississippi there are 114 short term general hospitals and 21 limited service clinics and hospitals. These are located in 72 of the state's 82 counties. If the number of beds is taken as a measure of size, the mean size of short term general hospitals (55) is four and one-half times greater than that of limited service clinics and hospitals (12). The range of bed size of acute short term general hospitals (9 to 350) is larger than that of limited service clinics and hospitals (2 to 40). Of the 6,566 short term hospital beds in the state in February, 1957, less than four percent were in limited service hospitals and clinics. Slightly over three quarters (77 percent) of the short term general hospitals are publicly-owned nonprofit operations, while 71 percent of the limited service hospitals and clinics are privately owned. In addition to short term general and limited service beds there were 5,580 beds in five nervous and mental hospitals, 650 beds in a tuberculosis hospital, 65 beds in two chronic disease hospitals and 15 beds in three other institutions.

Trends 1950-1957

The number of hospitals[2] in Mississippi fluctuated from 125 to 150 during the period, 1950-1957 (Table 1). The net increase for the seven-year period was only ten, from 125 to 135. However, when these are sorted by type of ownership, it becomes evident that county hospitals have increased more than threefold, from 15 to 48, since 1950. Individually-owned hospitals, most of them limited service clinics, on the other hand, declined sharply in number during the period. In many instances, their functions were transferred to new short term general county hospitals built with the assistance of Hill-Burton funds. A slight decline in the number of hospitals owned by nonprofit associations occurred from 1950 to 1957, while the number of hospitals owned by cities, church bodies, corporations, and the state remained largely unchanged.

Although the number of hospitals increased but slightly during the eight years under consideration, the same may not be said of the beds they contain. There was a 35 percent increase in the total number of hospital beds available to the people of Mississippi. More importantly, "acceptable" beds increased by 51 percent during the period while "non-acceptable" beds increased by only one-half of one percent. A majority of beds listed as "unacceptable" were so classified because of "excessive hazard to patients from fire" and for "obsolete construction not originally intended for hospital use and whose remodelling has not rendered it suitable for such use." Consequently, there has been an increase in the proportion of "accepatble" beds from a little more than two thirds of the total in 1950, to slightly more than three quarters of that number in 1957 (Table 2).

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[1] This report is part of a larger study of hospital-community relations made possible by a grant from the U. S. Public Health Service to the Division of Sociology and Rural Life, Mississippi State University.

[2] For the sake of brevity, "hospitals" here and hereafter, refers to short term general hospitals and limited service clinics. The same is true of hospital beds.

It should be noted that considerable variation occurs in Tables 1 and 2 for individual years, particularly 1952. This results from the ease with which small clinics can be opened and closed and also, in part, perhaps, to an uneven application of the criteria for bed acceptability.

Size of Hospitals

The size of Mississippi's hospitals is related to their number, bed capacity, and admissions in Table 3. Several observations are in order regarding these data. While the small hospitals constitute a relatively large proportion of the total number, they contain a small proportion of the beds and account for but a small share of the admissions. If the state's hospitals are divided into those with fewer than 50

Table 1. Number of short term general hospitals and limited service clinics by type of ownership,[1] Mississippi 1950-57.

Year	Indv. & P'nrship	Nonprofit Ass'n	County	City	State	Corporate	Church	Total
1950	50	40	15	6	5	4	5	125
1951	46	31	28	9	5	5	7	131
1952	52	35	37	8	6	5	7	150
1953	40	35	41	6	4	6	6	138
1954	33	34	41	6	5	5	6	130
1955	36	34	42	8	6	4	5	135
1956	36	33	45	8	7	4	5	138
1957	31	35	48	6	7	3	5	135

Source: Mississippi Commission on Hospital Care, **Mississippi State Plan for the Construction of Hospitals,** 1950-1957.

[1] "Individually" owned hospitals are those owned by a single individual. "Partnership" owned hospitals are owned by a partnership. Ownership by "nonprofit associations" includes all hospitals not organized for profit and owned by a corporation or a membership association, excluding church-affiliated hospitals which are designated as "church". The terms "city", "county" and "state" are self-explanatory. "County" hospitals include a small number of hospitals (5 in 1957) jointly owned by a city and a county. "Corporate" ownership refers to hospitals that are incorporated, but not on a nonprofit basis.

Table 2. Number of "acceptable" beds in short term hospitals and limited service clinics, Mississippi, 1950-1957.

Year	Acceptable	Non-Acceptable[1]	Total	Percent acceptable
1950	3,318	1,534	4,852	68
1951	3,597	1,542	5,139	70
1952	5,057	1,424	6,481	78
1953	4,263	1,786	6,049	71
1954	4,376	1,682	6,058	72
1955	4,754	1,313	6,067	78
1956	5,072	1,433	6,505	78
1957	5,024	1,542	6,566	77

[1] Reasons for non-acceptability listed by the Mississippi Commission on Hospital Care are as follows: "A. The institution is not licensed by the state agency and conditions or practices exist which render it unlikely it will be (sic) licensed in the near future. B. Qualifications for admission of, or services to, a patient or patients is so delimited that the hospital cannot be said to be rendering a community service. C. Excessive hazard to patients from fire. D. Obsolete construction or construction not rendering it suitable for such use."

Table 3. Hospitals, beds and admissions, number and percent, and admissions per bed and per hospital, for short term general hospitals and limited service clinics, by hospital bed size, Misisssippi, 1957.

	Hospitals		Beds		Admissions			
Bed size	No.	Percent	No.	Percent	No.	Percent	Per bed	Per hospital
Under 25	40	30	559	9	24,670	10	44	617
25-49	47	35	1589	24	66,505	26	42	1415
50-74	22	16	1232	19	46,920	18	38	2133
75-99	11	8	928	14	40,176	16	43	3652
100 & over	15	11	2258	34	75,482	30	33	5032
Total	135	100	6566	100	253,753	100	39	1880

Source: Mississippi Commission on Hospital Care, **Mississippi State Plan for the Construction of Hospitals, 1957.**

Table 4. Medians of selected hospital statistics, for short term general hospitals and limited service clinics, by hospital bed size, Mississippi.

				Facilities*		Births*	
Bed size	Percent occupancy	Cost per patient	No. of bassinets	No.	per bed	No.	Per bassinet
Under 25	47.5	$ 53.37	5	7	.39	140	24
25-49	55.5	63.42	6	7	.21	215	23
50-74	51.5	68.33	13	7	.13	311	21
75-99	62.5	91.33	18	8	.13	499	25
100 & over	64.5	110.00	21	12	.08	466	24

Source: Mississippi Commission on Hospital Care, **Mississippi State Plan for the Construction of Hospitals,** Rev. Ed. 1956.

*Cost per patient, facilities, and births from **Hospitals,** August 1955, pp 200-203.

beds and more than that number, it is seen that hospitals in the smaller size category constitute more than two thirds of the total number but have only approximately one third of the beds and admissions. Establishments with 100 or more beds, on the other hand, comprise only 11 percent of the total number of hospitals but account for 34 percent of the beds and 30 percent of the admissions.

The larger hospitals have a longer average length of stay. This is reflected in the percent of beds in a given bed-size category as contrasted with the percent of admissions in the same bed-size category. Hospitals in the smaller bed-size categories generally handle a percent of total admissions that is larger than their percent of total beds. They can do this because a short length of stay permits a greater number of admissions. For the larger hospitals the situation is reversed. Differences in the average length of stay among the various bed-size categories are also reflected in the number of admissions per bed. As might well be expected the number of admissions per hospital is positively associated with bed size.

The significance of the hospitals in the 25 to 49 beds group should not be overlooked. These institutions are dispensing a sizeable share of the hospital services rendered in the state. They constitute more than one third of the hospitals in Mississippi and in 1957 accounted for approximately one quarter of beds and admissions. If to these are added the eight hospitals with exactly 50 beds each, the importance of this group of small hospitals is further emphasized for they then comprise 41 percent, or two fifths, of all hospitals and contain 30 percent of all hospital beds.

Table 4 permits the relating of the medians[3] of given hospital statistics to bed size. Percent occupancy, cost per patient and the number of bassinets are shown to be positively associated with bed size.

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[3] The median is that point which divides the number of cases so that half are below the median and half are above.

The range in the cost per patient between small and large hospitals is particularly striking. In hospitals with 100 beds or more, the cost per patient ($110.00) was more than twice as high as in hospitals with fewer than 25 beds ($53.37). This reflects more costly hospital care **per se** as well as a longer average stay in the larger hospitals.

It will be noted that the number of facilities remains largely constant at all bed-size levels except the 100 beds and over category which has half again as many facilities as the remaining bed-size groups. This is because a given number of facilities is necessary to any hospital and also because a given facility can often serve a 25 bed hospital as easily as a 100 bed hospital. "Facilities" include such items as basal metabolism apparatus, blood bank, clinical laboratory, pharmacy, electroencephalograph, medical records department, radio-active isotope therapy department, diagnostic and therapeutic x-ray and others.[4] It is evident that seven or eight basic facilities meet the requirements of most hospitals under 100 beds in size. The larger hospitals tend merely to expand existing facilities rather than to add additional ones. Hospitals in the largest size category, however, render a substantially greater number of these services than do those of lesser size. This results from the addition of highly specialized equipment or facilities such as occupational therapy departments and radio-active isotope therapy departments. The nature of the facilities is reflected in the inverse relationship between bed size and the median of the number of facilities per bed. The data on births by bed size indicate that hospitals in the 100 beds and over group are utilized relatively to a lesser degree for obstetrical purposes than those having from 75 to 99 beds. Not only was the median number of births smaller in the large hospitals but the number of births per bassinet also. However, since bassinets may be added or subtracted from a nursery with relative ease, and since they do not represent the overhead of supply, equipment and personnel that the hospital bed does, variations in this figure are not very significant. This results from the fact that newborns are not ordinarily medical or surgical patients and make fewer demands upon the hospital's facilities and staff.

Size of Population Centers With Hospitals

Examination of Table 5 reveals that the following hospital "characteristics" are positively associated with the size of the town or city in which the hospital is located: number of hospitals per population center, average number of beds per hospital, average stay in days, and percent occupancy. The average stay in days and the percent occupancy are also positively associated with the size of the hospital. The larger hospitals are more fully utilized and tend to receive more severely ill patients who remain hospitalized longer. Thus, the positive association of these two indices with the size of the population center in which the hospital is located is a result of the similar association between the size of hospitals and of towns and cities with hospitals.

Towns and cities ranging in size from 1,000 to 10,000 inhabitants were the location of 63 percent of the state's hospitals and 44 percent of the hospital beds, attesting to the fairly wide distribution of these institutions throughout the state. Centers with 25,000 or more population had 20 percent of the hospitals and 39 percent of the beds, reflecting the not surprising fact that large centers are the location of the larger hospitals. It is also noticeable that

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[4] Others are central sterile supply room, dental department, electrocardiograph, medical staff library, obstetrical delivery room(s), occupational therapy department, major operating room(s) physical therapy department, post-operative recovery room, premature nursery, social service department, hospital auxiliary.

Table 5. Selected characteritics of short term general hospitals and limited service clinics by size of population center, Mississippi.

Size of center	Percent of hospitals	Percent of beds	Percent of admissions	Hospitals per center	Average No. of beds per hospital	Average stay in days	Percent occupancy
All places	100.0	100.0	100.0	1.4	48	5.1	60
Under 1,000	8	3	3	1.0	21	3.9	42
1,000-2,500	33	18	20	1.1	26	4.8	58
2,500-10,000	30	26	25	1.2	42	4.7	55
10,000-25,000	9	14	15	1.5	77	5.2	72
25,000-50,000	16	26	27	3.7	76	5.7	61
50,000 & over	4	13	10	6.0	143	6.0	62

Sources: U. S. Bureau of the Census, **U. S. Census of Population: 1950,** Vol. II, Part 24; Mississippi Commission on Hospital Care, **Mississippi State Plan for the Construction of Hospitals,** Rev. Ed., 1956.

there is considerable agreement between the percent of beds and of admissions in a given population center-size category. This is particularly evident if the six sizes of population center categories, shown in Table 5, are reduced to three. Thus hospitals located in towns of less than 2,500 inhabitants had 21 percent of the beds and 23 percent of the admissions. Similar figures for hospitals located in towns and cities of 2,500 to 25,000 and of 50,000 and over population are: 40 and 40, and 39 and 37. On the other hand, patients hospitalized in the larger hospitals had a longer average stay in days, reflecting a higher percent occupancy.

Hospital Beds in Relation to Population

The number of hospital beds per 1000 population for each county in Mississippi is shown in the accompanying map by the use of concentric circles. A quarter segment of the circles represents 2.5 beds per 1000 population, a half segment represents 5.0 beds, and the complete circle represents 10 beds. Counties having no hospital facilities are represented by blank circles.

Two indices are available for determining how nearly the hospital bed-person ratios in Mississippi and its counties approach recommended standards. One of these is provided by the Surgeon General's Office of the United States and recommends 4.5 hospital beds for each 1000 persons in the population. The other is provided by the Mississippi Commission on Hospital Care and recommends that intermediate (urban) hospital areas in the state have a bed-population ratio of 4.0 and that rural areas have a ratio of 2.5.

The map on page 2 shows quite a variation in the hospital bed-population ratios throughout the state and, especially, between counties that have large urban centers and counties whose populations are more largely rural. The greatest concentrations of hospital beds are found in major cities of the state. In Lauderdale, Jones, Forrest, Adams, Washington, and Warren Counties which contain, respectively, the cities of Meridian, Laurel, Hattiesburg, Natchez, Greenville, and Vicksburg, the hospital bed-person ratios are in excess of the recommendations of both the Surgeon General and the Mississippi Commission on Hospital Care. In Harrison, Jackson, and Lowndes Counties, whose populations also are predominantly urban, the hospital bed-person ratios are just over 2.5.

Thirty-four predominately rural counties in the state that have hospital facilities have fewer than the 2.5 beds per 1000 population recommended for rural areas by the Mississippi Commission on Hospital Care. Twenty-seven counties with predominately rural populations have hospital bed-person ratios in excess of the Commission's recommendation. The ten counties without hospital facilities are all predominately rural.

The above analysis of hospital bed-person ratios in Mississippi according to the two stated indices is useful for comparative purposes. However, what actually constitutes an ideal hospital bed-person ratio is a difficult question to answer. The optimum number of hospital beds for any given population is dependent on a variety of factors, including not only the size and nature of the population but also the economic resources, the patterns of hospital utilization, the local leadership, and the needs for hospitalization within the area. Consequently, 2.5 hospital beds for each 1000 persons in predominately rural areas may quite well be sufficient while 4 or more beds per 1000 persons in highly urbanized areas may be necessary. In either case, an over-supply of hospital beds that can be neither fully utilized nor supported is highly inefficient.

Mississippi, as a whole, had a hospital bed-person ratio of 3.1 in 1955. As new hospitals are opened and currently planned expansions of existing facilities are completed this ratio is certain to increase

Summary

Between 1950 and 1957 the number of short term general hospitals and limited service clinics in Mississippi increased from 125 to 135. The number of beds in these hospitals considered "acceptable" by the Mississippi Commission on Hospital Care increased from 3,318 to 5,024, or by 51 percent, during the same period.

More than three fourths of the general short term hospitals in the state are publically owned, nonprofit institutions. Nearly two thirds of them have fewer than 50 beds but account for approximately one third of all beds devoted to short term hospital care.

Hospitalization costs are greater in the larger hospitals. In 1957 the average cost per patient in hospitals and clinics with fewer than 25 beds was $53.37 as compared with $110.00 in hospitals with 100 or more beds. This difference is caused primarily by longer periods of hospitalization per patient and more expensive specialized personnel and equipment characteristic of the larger hospitals.

The hospitals and clinics are widely distributed throughout the state. Small towns of less than 2,500 population are the location of two fifths of the hospitals and clinics and of one fifth of the hospital beds devoted to short term care.

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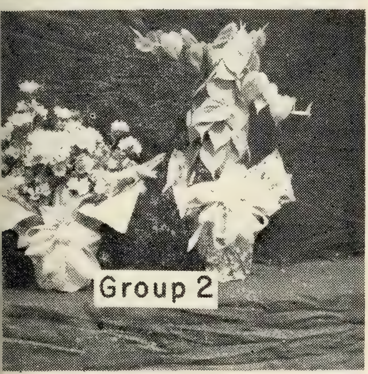
BULLETIN 565 SEPTEMBER 1958

Group 1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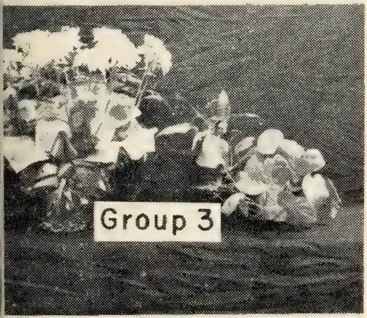
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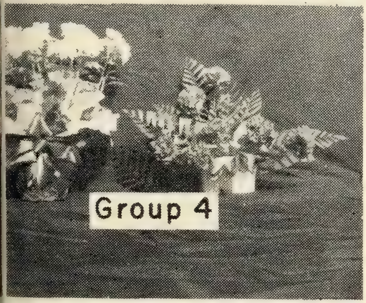
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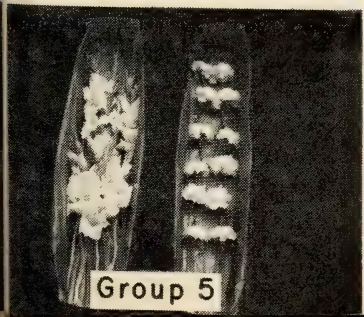
Group 5

Consumer Preferences For Cut Flowers And Pot Plants In Mississippi

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CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

On the cover:

Consumers in this study were given their choice of the five groups shown on the cover.

Group 1. Pot chrysanthemum and azalea.

Group 2. Azalea and foliage plant, Philodendron cordatum on a totem.

Group 3. Pot chrysanthemum and container of foliage plants.

Group 4. Pot chrysanthemum and arrangement of red carnations.

Group 5. Twelve gladioli and twelve carnations, unarranged.

CONSUMER PREFERENCE FOR CUT FLOWERS AND POT PLANTS IN MISSISSIPPI

By ROBERT E. LeCLERG

Introduction

In recent years, florists have become concerned with developing new markets for flowers. Consumer incomes have increased over 50 percent during the past decade. More people can now provide for their basic needs and have money left for "luxuries" such as flowers.

Since production must be geared to the wants of the buying public, this study of flower preferences in Mississippi was undertaken by the Agricultural Experiment Station.

Procedure

The sample was based on the Home Demonstration Clubs of the Mississippi Extension Service. This limited the sample to women, however, it is generally believed that women make most decisions regarding flower purchases.

Six counties were randomly selected out of each of the four supervisory districts of the state.[1] A visit was made to the County Home Demonstration Council meeting, usually held in the county seat of each selected county. This council was composed of the officers of the various Home Demonstration Clubs throughout the county. The survey was made during February, March, April, and May, 1958.

Each individual was asked to indicate her preference from a series of comparisons of blooming pot plants, cut flowers, and foliage plants which were on display (See cover page). For the purpose of this study, those items used were considered at an equivalent retail price. Additional information was obtained concerning other preferences for flowers and colors, buying habits, and opinion on vital areas of interest in flower marketing. Personal data, such as age educational level, gross income, and residential classification, were obtained for evaluation purposes.

Results

Each individual surveyed was shown a series of pairings and asked the following question: "Assuming you were making a purchase for enjoyment in your home, which of the two selections in each group would you prefer?" Table 1 shows the preferences expressed within each group.

The most pronounced result of this comparison study was the overwhelming preference for a foliage plant over an azalea (Group 2). Over 70 percent selected the foliage plant, Philodendron cordatum on a totem. The choice of gladioli over carnations (Group 5) by nearly 64 percent of the individuals indicated their desire for flowers with as many blooms and as much color as possible, and with longer lasting enjoyment.

Although price was considered comparable, preferences indicated that a pot plant was favored over an arrangement of cut flowers (Group 4), with more than 63 percent selecting the potted chrysanthemum rather than a red carnation arrangement. Further evidence of the popularity of foliage plants is shown in Group 3 in which an arrangement of foliage was chosen over a pot chrysanthemum by nearly 61 percent of the sample. It is interesting to note that there was a very slight preference for an azalea over a pot chrysanthemum (Group 1).

Undoubtly one of the most convincing results of this study showed an almost unanimous choice of a blooming pot plant over a cut flower arrangement to be given as a gift. Nearly 92 percent indicated they preferred pot plants, giving mainly as their reason, the fact that potted plants last longer and can be transplanted outside in the garden. Of the comments by the 7 percent who preferred to give an

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[1] In planning a travel itinerary, one of the 24 counties could not be scheduled.

Table 1. Preferences for several cut flower and pot plant combinations.

	GROUPINGS									
	I		II		III		IV		V	
	Pot Chrysanthemums	Azalea	Azalea	Plant Foliage	Pot Chrysanthemums	Foliage Arrangement	Pot Chrysanthemums	Carnation Arrangement	Gladioli	Carnations
Total Responses	348	369	205	513	278	439	458	256	461	252
Percent Total Responses	48.3	51.2	28.4	71.2	38.6	60.9	63.5	35.5	63.9	34.9
No Answer	4		3		4		7		8	

Table 2. Color preferences for gladioli, roses, carnations, and chrysanthemums.

	FLOWER							
	Gladiolus		Rose		Carnation		Chrysanthemum	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Red	86	11.9	404	56.0	277	38.4	13	1.8
White	127	17.6	48	6.7	138	19.1	91	12.6
Pink	238	33.0	104	14.4	230	31.9	28	3.9
Yellow	91	12.6	120	16.6	15	2.1	407	56.4
Mixed	138	19.2	14	1.9	20	2.8	71	9.8
Other	12	1.7	3	0.4	3	0.4	68	9.4
No Answer	29	4.0	28	3.9	38	5.3	43	6.0
Total	721	100.0	721	100.0	721	100.0	721	100.0

arrangement of cut flowers, most prevalent was that it seemed more personal and individual, and would be more pleasing in appearance.

The universal appeal of red roses was borne out in the results of the color preference portion of this study (Table 2). Fifty-six percent of those surveyed singled out the red rose as their favorite colored rose. The overall results compared favorably with a similar study conducted by the Ohio Agricultural Experiment Station.[2] Gladioli were not used in the Ohio project, but their sample[3] indicated red as the most popular color for both roses and carnations, and yellow for chrysanthemums.

Preference for yellow chrysanthemums appeared as definite as in the case of red roses, with 56 percent choosing that color in both studies. Pink carnations were found to be the second choice in this survey, while white was runner-up in Ohio. There does not seem to be as definite a favoritism for colors in the gladiolus. Pink was the more popular color, being selected by 33 percent, but it will be noted that nearly 20 percent indicated a preference for mixed colors.

Results of the question of mixed versus solid color flower arrangements were interesting because of a complete reversal as compared to the Ohio study. Almost 70 percent of the Mississippians preferred solid colors, with 28 percent selecting mixed color designs, but in Ohio, 82 percent stated they liked arrangements of several colored flowers, while only 16 percent chose solid colors. One possible explanation for this difference is the difference in sampling areas. The Ohio consumer panel was representative of a large metropolitan area, while in Mississippi the sample represented a predominately rural population. Perhaps florists in larger cities have more occasion to design arrangements using two or more colors, and the public has accepted mixed colors.

This survey showed that 60 percent of those individuals interviewed did not believe floral products were excessively expensive. Typical of the remarks made by some of the 34 percent who did indicate they felt flowers were excessively high in price were: "Too expensive to last so short a time", and "For the price they are not enjoyed very long". One individual stated that she felt "too much decoration (ribbon) is used that runs up the price and takes away the beauty of the flowers."

Other general comments included: "Prices go up on special occasions", "You don't usually get as good a quality as you should for the money paid", "They are higher in Mississippi than other places", and "Out of line for average wage earner, disrupts budget".

The public desire for flowers at a lower price was evidenced by many remarks such as "We should use more (flowers) than we can afford", "If prices were lower, consumers would buy more", and "Can go elsewhere and get the same for less". Then there was the blunt person who said that "most (florists) are like everything else trying to get all they can—fast". But there was one who did not feel floral products were expensive, commenting that "this work requires skilled workmanship".

When asked to indicate how often flowers and pot plants were purchased for home use and enjoyment, it was found that more than 60 percent did so only one or two times a year. Over 15 percent bought flowers three or four times, while only 5 percent purchased floral products more than five times a year. Only 16 percent of the sample stated they never bought flowers for this purpose.

Each person was asked her educational

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[2] Sherman, R. W., Kiplinger, D. C., and Williams, H. C. **Consumer Preferences for Cut Roses, Carnations, Chrysanthemums,** Ohio Agricultural Experiment Station, Wooster, Ohio, March, 1956.

[3] Sample consisted of a consumer panel of 100 individuals drawn from the population of Columbus, Ohio.

level, gross income,[4] age, and residential classification. Below is a summary of this information

Educational level:		Gross Income:	
Grade School	10.4%	$1,000-$2,999	19.8%
High School	58.0%	$3,000-$4,999	30.2%
College	20.5%	$5,000-$7,499	16.2%
Graduate Study	4.7%	$7,500 over	6.9%
No answer	5.5%	No answer	26.8%

The results showed that 80 percent of those questioned owned their own home, with 13 percent renting, and the balance not answering. The average age of the sample was 46.3 years.[5]

By placing all questionnaire information on IBM punch cards, it was possible to study the inter-relationship between a number of the questions asked and such factors as age, income, and education.

Opinion as to the cost of floral products, for example, was found not to be related to income, age, education, residential classification, or frequency of purchase (Tables 3,4,5,6, and 7). However, over 45 percent of the individuals who never buy flowers believed them to be excessively expensive. (Table 7). On the other hand, only 33 to 36 percent of those who do buy flowers for home enjoyment felt that flowers are excessively high in price.

In Table 4, which shows the relationship of age to this question of expensiveness, an increasing percentage of individuals, as their age increased, indicated flowers were too expensive. At age 66 and over the percentage dropped from 39 to 25 percent.

Data shown in Tables 8, 9, 10, and 11 indicate that income, age, residential classification, and education had little if any influence on the choice of pot plants or cut flowers to be given as a gift. In each case, on the average, about 93 percent of the individuals preferred blooming potted plants rather than arrangements of cut flowers. This figure is equivalent to that percentage of the entire sample of 721 individuals who chose pot plants. Slight variations from the average will be noted in several cases. In the $5,000-$7,499 income bracket, for example, 10.5 percent indicated a preference for cut flowers as compared to an average of 7 percent for the entire group (Table 9). Similar results are to be found in the

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[4] In most cases this was the gross income of the lady's husband.

[5] Median age was found to be 47 years.

Table 3. Relationship of gross income to opinion as to whether floral products are excessively expensive.[1]

	GROSS INCOME				Percent total responses
	$1,000-2,999	$3,000-4,999	$5,000-7,499	$7,500 & Over	
Expensive	35.6	37.0	37.3	36.7	36.7
Not Expensive	64.4	62.9	62.7	63.3	63.3
Total	100.0	100.0	100.0	100.0	100.0
Total Responses	135	208	110	49	502[2]

[1] Chi Square, 3 degrees of freedom, 0.1002, probability of larger value is greater than .99. with no association.

[2] Comprises 69.6% of total individuals interviewed.

Table 4. Relationship of age to opinion as to whether floral products are excessively expensive.[1]

	A G E					Percent total responses
	Up to 35	36-45	46-55	56-65	66 & over	
Expensive	31.5	35.0	36.6	39.3	25.0	35.0
Not Expensive	68.4	65.0	63.4	60.7	75.0	65.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Total Responses	133	157	183	112	32	617[2]

[1] Chi Square, 4 degrees of freedom, 7.5542, probability of larger value is between .20 - .10, with no association.

[2] Comprises 85.6% of total individuals interviewed.

Table 5. Relationship of educational level to opinion as to whether floral products are excessively expensive.[1]

	EDUCATIONAL LEVEL				Percent total responses
	Grade School	High School	College	Graduate Level	
Expensive	36.1	33.7	38.6	36.4	35.2
Not Expensive	63.9	66.3	61.4	63.6	64.8
Total	100.0	100.0	100.0	100.0	100.0
Total Responses	72	395	140	33	640[2]

[1] Chi Square, 3 degrees of freedom, 1.1488, probability of larger value is between .80 - .70, with on association.

[2] Comprises 88.8% of total individuals interviewed.

Table 6. Relationship of residential classification to opinion as to whether floral products are excessively expensive.[1]

	RESIDENTIAL CLASSIFICATION		Percent total responses
	Owner	Renter	
Expensive	35.4	36.3	35.5
Not Expensive	64.6	63.7	64.5
Total	100.0	100.0	100.0
Total Responses	545	91	636[2]

[1] Chi Square, 1 degree of freedom, 0.0200, probability of larger value is between .90 - .80, with no association.

[2] Comprises 88.2% of total individuals interviewed.

Table 7. Relationship of the frequency of purchase of flowers and plants for home enjoyment to the opinion as to whether floral products are excessively expensive.[1]

	Frequency of Purchase				Percent total responses
	1 or 2 times	3 or 4 times	5 or more	Never	
Expensive	33.6	35.9	35.1	45.5	36.0
Not expensive	66.4	64.1	64.9	54.5	64.0
Total	100.0	100.0	100.0	100.0	100.0
Total Responses	414	103	37	112	666[2]

[1] Chi Square, 3 degrees of freedom, 5.4866, probability of larger value is between .20 - .10, with no association.

[2] Comprises 92.4% of total individuals interviewed.

Table 8. Relationship of gross income to the preference for cut flowers or blooming pot plants as a gift.[1]

	GROSS INCOME				Percent total responses
	$1,000-2,999	$3,000-4,999	$5,000-7,499	$7,500 & Over	
Expensive	6.4	6.5	10.5	4.0	7.1
Not Expensive	93.6	93.5	89.5	96.0	92.9
Total	100.0	100.0	100.0	100.0	100.0
Total Responses	141	216	114	50	512[2]

[1] Chi Square, 3 degrees of freedom, 7.5649, probability of larger value is between .10 - .05, with no association.

[2] Comprises 72.3% of total individuals interviewed.

66-and-over age group (Table 9), and the college level group (Table 11).

A definite association was found between residential classification and frequency of purchase of flowers and plants for home enjoyment (Table 12). Sixty-four percent of those individuals owning their homes bought flowers only one or two times a year, while less than 48 percent of those who rent did so. Of those who stated they never purchased flowers, over 23 percent were in the renter category. This was 7.5 prcent above the average. Less than the average were found to be owners (14.7 percent).

There were indications of some relationship between educational level and frequency of purchase (Table 13). Considerably fewer individuals with at least a college education stated they never bought flowers or plants for their own pleasure. Ten percent more of the people with a college education purchase floral products three or more times a year than those with up to a high school level of education. No association was found with respect to age (Table 14) and income (Table 15).

Summary

The purpose of this study was to determine consumer preferences in Mississippi for various cut flowers and pot plants. Members of the Home Demonstration Councils throughout the state were inter-

Table 9. Relationship of age to the preference for cut flowers and blooming pot plants as gifts.[1]

	AGE					Percent total responses
	Up to 35	36-45	46-55	56-65	66 & over	
Cut Flowers	6.7	4.3	8.4	7.8	11.1	7.0
Pot Plants	93.3	95.7	91.6	92.2	88.9	93.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Total Responses	135	164	191	116	36	642[2]

[1] Chi Square, 4 degrees of freedom, 3.4937, probability of larger value is between .50 - .30, with no association.

[2] Comprises 89.0% of total individuals interviewed.

Table 10. Relationship of residential classification to the preference for cut flowers and blooming pot plants as a gift.[1]

	RESIDENTIAL CLASSIFICATION		Percent total responses
	Owner	Renter	
Cut Flowers	7.4	6.3	7.2
Pot Plants	92.6	93.7	92.8
Total	100.0	100.0	100.0
Total Responses	571	95	666[2]

[1] Chi Square, 3 degrees of freedom, 5.8837, probability of larger value is between .20 - .10, with no association.

[2] Comprises 92.4% of total individuals interviewed.

Table 11. Relationship of educational level to the preference for cut flowers and blooming pot plants as a gift.[1]

	EDUCATIONAL LEVEL		Percent total responses
	High School or below	College or above	
Cut Flowers	5.3	10.6	6.7
Pot Plants	94.7	89.4	93.3
Total	100.0	100.0	100.0
Total Responses	487	180	667[2]

Chi Square, 1 degree of freedom, 5.6925, probability of larger value is between .02 - .01, with no association.

[2] Comprises 92.5% of total individuals interviewed.

Table 12. Relationship of the frequency of purchase of flowers and plants for home enjoyment to residential classification.[1]

Frequency of of purchase	RESIDENTIAL CLASSIFICATION		Percent total responses
	Owner	Renter	
1 or 2 times	64.4	47.9	62.1
3 or 4 times	15.2	24.5	16.5
5 or more	5.7	4.2	5.5
Never	14.7	23.4	15.9
Total	100.0	100.0	100.0
Total Responses	565	94	659[2]

[1] Chi Square, 3 degrees of freedom, 11.85.31, probability of larger value is less than .01, with no association.

[2] Comprises 91.4% of total individuals interviewed.

Table 13. Relationship of educational level to the frequency of purchase of cut flowers and plants for home enjoyment.[1]

Frequency of of purchase	EDUCATIONAL LEVEL		Percent total responses
	High School or below	College or above	
1 or 2 times	63.6	58.1	62.1
3 or 4 times	14.6	19.6	15.9
5 or more	4.1	9.5	5.6
Never	17.7	12.8	16.4
Total	100.0	100.0	100.0
Total Responses	486	179	665[2]

[1] Chi Square, 3 degrees of freedom, 11.3238, probability of larger value is between .02 - .01, with no association.

[2] Comprises 92.2% of total individuals interviewed.

viewed, and asked to indicate their preferences from among several pairs of cut flowers, pot plants and foliage plants which they were shown. In addition, answers to various questions on color preference, buying habits, and personal data were obtained.

The average person interviewed had attained at least a high school education, was earning between $3,000 and $5,000, owned her home, and was about 47 years old.

A decided preference was found for foliage plants as compared to either an azalea or a pot chrysanthemum, and among cut flowers, gladioli were more popular than carnations. Blooming pot plants were an overwhelming choice over cut flower arrangements for gifts.

Red roses, yellow chrysanthemums, red carnations, and pink gladioli were the favorite in colored flowers. The majority of the individuals preferred the use of solid rather than mixed colors in an arrangement.

Sixty percent of the sample did not feel floral products were excessively expensive, while more than this number only bought flowers and plants for home enjoyment one or two times a year.

Opinion as to the expensiveness of floral products was found not to be related to income, age, education, ownership of residence, or frequency of purchase. Likewise, the preference for cut flowers to pot plants as gifts was not associated with these five classifications.

Definite association was found between residential classification and the frequency of purchase of flowers for home enjoyment; and, there were indications that some relationship existed between educational level and frequency of purchase.

Conclusions

Results of this survey emphasize the need for the florist industry to study new methods of providing more flowers for more people. The consumer knows and appreciates the benefits of flowers, and wants to enjoy them more often in the home. It remains for the industry to activate this demand by providing acceptable flowers at prices which will satisfy this desire.

Generally speaking, the public does not believe floral products are excessively expensive, considering the high cost of living today. It is more a case of providing for the necessities first, and then with those spendable dollars that remain, enjoy certain "luxuries". Proper consumer education will help to overcome a feeling by some that flowers are too expensive. The use of new merchandising methods, such as "cash and carry" selling, will open new avenues of floral enjoyment for that part of the population whose income does not warrant frequent purchase of flowers.

The fact that there is a greater preference for potted plants than for arrangements of cut flowers, is another indication that more cut flowers should be made available at attractive prices. In addition, the flower buying public should be given every opportunity to learn to effectively use the cut flowers they buy. When more people know the basic principles of floral design, they will become desirous of using more flowers in their homes.

Table 14. Relationship of age to the frequency of purchase of cut flowers and plants for home enjoyment.[1]

Age	FREQUENCY OF PURCHASE				Percent total responses
	1 or 2 times	3 or 4 times	5 or more	Never	
Up to 35	21.4	20.4	22.2	21.2	21.2
36 - 45	24.4	24.3	27.8	31.3	25.6
46 - 55	30.4	33.0	30.6	26.3	30.2
56 - 65	17.3	18.4	16.7	17.2	17.5
66 and over	6.5	3.9	2.7	4.0	5.5
Total	100.0	100.0	100.0	100.0	100.0
Total Responses	398	103	36	99	636[2]

[1] Chi Square, 12 degrees of freedom, 4.6814, probability of larger value is between .98 - .95, with no association.

[2] Comprises 88.2% of total individuals interviewed.

Table 15. Relationship of gross income to the frequency of purchase of cut flowers and plants for home enjoyment.[1]

Gross income	FREQUENCY OF PURCHASE				Percent total responses
	1 or 2 times	3 or 4 times	5 or more	Never	
$1,000 - 2,999	28.3	26.6	6.7	21.3	25.5
$3,000 - 4,999	41.8	41.5	43.3	26.9	38.9
$5,000 - 7,499	20.8	22.3	33.3	17.6	21.1
$7 500 & over	9.1	9.6	16.6	6.5	9.1
Total	100.0	100.0	100.0	100.0	100.0
Total Responses	318	94	30	108	550[2]

[1] Chi Square, 9 degrees of freedom, 16.5665, probability of larger value is between .10 - .05, with no association.

[2] Comprises 76.3% of total individuals interviewed.

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BULLETIN 566 **SEPTEMBER, 1958**

Industrialization in Chickasaw County, Mississippi

A Study of Plant Workers

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

In cooperation with Agricultural Marketing Service,
U. S. Department of Agriculture

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FOREWORD

This report is based on a survey conducted by the Mississippi Agricultural Experiment Station in cooperation with the Agricultural Marketing Service of the United States Department of Agriculture.

The President, in a message to Congress in January 1954, expressed the need for a concerted attack on the problems of low income areas. The Rural Development Program was conceived to meet this need through the combined efforts of interested local and State organizations with coordinating assistance from the Federal Government.

Much interest has been engendered in recent years in the possibilities of rural industrialization as one means of raising levels of living in low income rural areas.

This study is one of several now under way under the joint sponsorship of the Agricultural Marketing Service and State Agricultural Experiment Stations. In addition to Mississippi, State Experiment Stations involved are Louisiana, Ohio, Iowa and Utah. Brigham Young University is also participating in the Utah project jointly with USES and AMS. It is hoped that these studies will shed some light on the social and economic changes involved in the establishment of industrial plants in rural communities and their implications for rural development.

SUMMARY

This study attempts to appraise the effects of industrialization on selected residents of a rural Mississippi community. Specifically, this report examines some demographic and socio-economic characteristics of employees of a factory which has recently been established in the town of Houston, Chickasaw County, in north central Mississippi. It focuses mainly on plant employees with a few comparisons with a cross section of rural residents living in the survey area. A later report will enlarge upon these findings and will also include an intensive comparative analysis of the sample of rural residents.

The factory workers were comparatively young (over 50 percent were under 30 years of age), most were heads of families and the majority had children of school age or younger.

One-fourth of the plant workers were also operating farms and another fifth of the workers had operated farms within the last ten years. Only a small number of the farms currently operated by the plant workers would qualify as "commercial" enterprises. About 40 percent of the workers lived in towns or villages, the rest divided about evenly between farm and open-country nonfarm residences. Factory workers exhibited a greater tendency to change residence than the average rural resident in the community.

Workers in the plant also had changed jobs more often than rural residents. However, workers who had the greatest number of job changes were those who had worked in other factory or nonfarm jobs; only about 20 percent of the workers had shifted directly from farm to factory work.

The industrial workers, in general, had a higher level of living as indicated by such items as electric lights, running water, refrigerators, etc., than a cross-section of rural residents. They also had increased their level of living at a faster rate in the last few years than rural residents in the community. Median income of plant worker families from all sources was higher than that of local rural families in 1956. Plant workers who had shifted directly from farming to factory work had lower average incomes than those who had shifted from other factory jobs, indicating that earlier industrial experience tends to increase the workers' earning power.

Practically all plant workers were agreed that the factory had benefited the community. A majority of rural residents also thought the factory had helped the community but about 25 percent had formed no opinion on the matter. The most frequently named reason given for the favorable attitudes toward the factory was that it had brought more money and jobs to the community.

Differences in the patterns of social activity of plant workers and rural residents were largely inconclusive. Rural residents showed a slightly greater tendency to join organizations than did plant workers. Religious activities were the primary or only social activity of a majority of plant workers and rural residents in general.

About a fourth of the plant workers also operate farms, and about the same number have operated farms in the last ten years. For most workers now operating farms, farm income represents a minor share of their total earnings. Most of the part-time farmers apparently consider their farming as a temporary addition to their income; very few intend to continue farming indefinitely.

Industrialization In Chickasaw County, Mississippi
A Study of Plant Workers

Sheridan T. Maitland and George L. Wilber*

INTRODUCTION

One of the most striking developments in the South in recent years has been the rapid growth of industrialization. For the most part, new industries have located in the larger towns and cities where industrial and shipping facilities are abundant and the labor force is skilled in industrial crafts. Some industrial plants have been established in the smaller towns and villages. Because these plants are an important new economic force in an increasing number of rural communities, the effects of this development are significant to those interested in the changing patterns of rural living in the South and elsewhere. Analysis of the impact of industrial development on farm families and rural communities was the basis for a study conducted in the Spring of 1957 in Chickasaw County, Mississippi. This bulletin is a report of the findings developed in one phase of the study: the effects of industrial employment on levels of living, scale of farming operations, participation in community affairs and attitudes toward the community of rural area residents who had taken jobs in a new local factory. A final report will provide a more intensive analysis of these effects and a comparison with results of a parallel investigation of a representative sample of local rural residents.

Need for the study

For over two decades the State of Mississippi has been engaged in a program to balance the State's agricultural base with an industrial base. During this period Mississipi's population has remained relatively stable at slightly more than 2,000,000. Meanwhile, the proportion of the population living on farms had declined from two-thirds to one-half. Over one-half of the farmers in Mississippi had gross incomes from the sale of farm products of less than $1,200 in 1949. The exodus from farms has been encouraged by the condition of almost unbroken full employment since early in World War II.

The Rural Development Program, inaugurated by the U. S. Department of Agriculture in 1954, has focused attention on low-income farm families and helped to crystalize action in the form of State and local community programs designed to raise rural incomes. One course of action suggested is the encouragement of location of industrial plants in rural communities to provide jobs for underemployed rural labor. Industrial payrolls in turn will stimulate the growth of trade and service enterprises, strengthen the economic base of the local community and provide additional jobs for the local labor force. This study provides an excellent opportunity to assess the effectiveness of Mississippi's industrial development program and similar programs elsewhere in raising the levels of living in low-income rural areas and the effects of new industries on farm families, the farm enterprise, and rural community institutions.

Objectives of the study

While the initial effect of a new industry is to increase employment and income within the community, the plant's effects on the rest of the local economy and on local institutions is less obvious. A new plant in a predominantly rural area can usually meet or better the prevailing wage scale and compete for the most skilled workers available. How does this affect farming operations in the community? Will farm operators seek jobs in the factory and if so, will they continue to operate their farms? Will part-time farming become more prevalent? Does the new industry help to bring about a change in the social life of the community; for example, do people take part more or less in social and civic functions as a part of a new pattern of living? What is the attitude of the people toward the factory and does the coming of the factory alter their outlook toward their community? What are the implications of the influx of industrial plants in rural communities for action programs of the State and Federal governments, such as the Extension Service, Public Health agencies, the Social Security Administration, and the Rural Development Program? Answers to these questions were the general objectives of this study. Findings produced from interviews with workers in the Jackson Manufacturing Company, a furniture factory established in the town of Houston in 1954, will be presented in this report.[1]

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*From the Agricultural Marketing Service, United States Department of Agriculture, and the Department of Sociology and Rural Life, Mississippi State University respectively.

The survey locale—Chickasaw County

Chickasaw County is located in north central Mississippi, on the edge of the Black Prairie. Because of the difficulties of maintaining cotton acreages due to soil erosion, insects and increasing competition, farming in the area has evolved from the old plantation cotton economy to mixed cotton, dairy and cattle production. The livestock and dairy farms are modest in size. Cotton farms are somewhat larger than in the Black Prairie area to the East. Despite the great changes in farming which have occurred in the past generation, it has been estimated that an efficient agricultural economy in the area would require and support little more than half of the farm families living in the area in 1950.[2] The average farm was about 100 acres in 1954. County farm land including buildings was valued at about $48.00 an acre. The proportion of tenant farms dropped from over 53 percent in 1950 to 47 percent in 1954 following the general nation-wide trend.

The population of Chickasaw County was 18,951 according to the 1950 Census. Nearly 45 percent of the county's population was nonwhite in that year. About 65 percent were living on farms and the rest were classified as rural-nonfarm residents. The estimated population in 1956 was 17,100. Allowing for births and deaths during the period, a net loss due to migration of over 3,600 was estimated between 1950 and 1956, of which over 2,000 were nonwhite (table 1). There are no urban places in the county. Houston, population 1,800, is the county seat.

Educational attainment in Chickasaw County compared favorably with the U. S. average for the rural farm and nonfarm population in 1950 and was higher than the average for the State of Mississippi.

Variations in participation in the labor force gives some indication of the way in which local socio-economic institutions affect the labor market. Seventy eight percent of the males in Chickasaw County, 14 years of age and over, were in the labor force at the time of the 1950 Census, about the same percentage reported for the United States as a whole. Only 21 percent of the Chickasaw women were working or looking for work, however, compared with 28 percent throughout the country. Considering the rural population separately, the women of Chickasaw Coun-

Table 1. Population and Migration in Chickasaw County, Mississippi, 1950 and 1956.

	Total	White	Nonwhite
Estimated Population, July 1, 1956	17,100	9,800	7,300
Enumerated Population, April 1, 1950	18,951	10,525	8,426
Natural Increase, 1950-56	2,094	875	1,219
Net Migration, 1950-56	—3,648	—1,450	—2,198
Loss to Armed Forces, 1950-56	205	105	100

Sources: Table 6b, Supplement to Mississippi Counties, Sociology and Rural Life Series No. 6. 1950 Census of Population, Vol. II, Part 24, Mississippi.

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[1] The furniture factory had been operating about two years and employed approximately 130 workers. An attempt was made to interview all employees except the plant manager and his secretary. One hundred-six usable schedules were obtained from the plant workers.

[2] Parvin, D. W., "The Nature of an Efficient Agriculture in the Northeast Prairie Area of Mississippi," Miss. Agr. Exp. Station Bulletin 459, Jan. 1949. p. 20.

ty had a slightly higher rate of labor force participation than rural women for the entire State.

About 57 percent of all employed persons in Chickasaw County were working in agriculture at the time of the 1950 Census; only nine percent were employed in manufacturing; and the rest were engaged in trade and service occupations.

How the survey was made

Because the study design called for a unique combination of conditions, none of which could be controlled by the researchers, the selection of a suitable survey area required a careful examination of possible sites. Although many rural communities in Mississippi had some of the required conditions, none was found which met all of the requirements of the survey. Chickasaw County came nearest to meeting the ideal conditions for a survey of the impact of industrialization in rural areas. It was predominantly rural, average farm income was low and a new industrial plant had recently been established in Houston, the county seat. Although the new factory payroll was small, it was expected that the economic and social effects of over 130 new jobs would be substantial in relation to the size and general economic level of the community.

A schedule containing a series of questions on personal and family characteristics, work experience, income, level of living, farm operations, and attitudes toward the factory and community was administered to two groups: (1) all of the workers on the payroll of the furniture factory in Houston, and (2) a sample of rural residents living in the area surrounding Houston.[3]

A total of 414 persons were interviewed, 106 employees of the furniture plant and 308 heads of rural families. As nine of the plant workers also were rural residents, the number of rural households surveyed was 317. Some of the rural household heads interviewed worked at industrial plants or other nonfarm jobs in nearby communities. The occupational and household components of the samples are shown in table 2.

Table 2. Major Components of the Sample, Chickasaw County, 1957.

	Plant Sample*	Open-Country Sample**
Respondents	106	317
Household Heads	79	317
Adult Family Members	273	781
Furniture Plant Workers	106	9
All Other Nonfarm Workers		
Wage and Salary	—	88
Self-Employed	—	18
Not Reported	—	55
Farm Operators	27	202
Farm Wage Workers	—	2

*Includes nine furniture plant workers who also were selected in the open-country sample.

**Includes nine open-country residents who were also employees of the furniture plant.

Characteristics of Plant Workers

Who works in the plant?

An industrial plant brings many new and different job opportunities to a rural community. What people in the community seek jobs in the plant? Do the people taking employment differ essentially from the rest of the employable population? Does the new plant tap a particular segment of the labor force? Answers to these questions will provide some hint of the impact of an industrial plant on a predominantly rural community. Table 3 shows the distribution of plant workers by age and sex. The most striking fact is the predominance of young males on the plant payroll.[4] Nearly two out of five workers were under 25 years of age

Table 3. Distribution of Plant Workers by Age and Sex, Chickasaw County, 1957.

Age	106 Plant workers	Sex	
		89 Males	17 Females
	Percent	Percent	Percent
Total	100	100	100
Under 25	39	42	24
25 - 29	16	18	6
30 - 34	21	20	29
35 - 39	13	11	24
40 - 44	6	5	11
45 - 49	4	3	6
50 and over	1	1	—

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[3] Beat 3, the eastern portion of Chickasaw County, was not included in the survey area because the employment and commerce of that part of the county centers largely in Okolona, the only population center of over 1,500 in the county other than Houston.

[4] Throughout the report, the 106 workers interviewed are assumed to be representative of the entire plant work force of approximately 130.

and less than one in ten was over 40. Less than one-sixth of the plant work force were women. The median age of female workers in the plant was 33.5 years, the median age of males was 27.3 years. Women in their thirties are likely to have children of school age and to be relatively free to take jobs compared to mothers of pre-school age children. Most of the women in the plant were probably holding their first nonfarm jobs.

The great majority of the plant workers were family breadwinners. Less than a fifth of the work force was single. About 80 percent of the men and nearly all of the women in the plant were married. About two out of three workers had children of school age or younger. Most of the rest were heads of young, all-adult families. There were no Negroes employed in the plant.

One of the important questions arising with the advent of industrial job opportunities in rural areas is the extent to which farm operators seek plant jobs and how such off-farm work will affect their farm operations. One-fourth of all the plant workers interviewed were also operating farms. About half of the 27 workers who operated farms had been farming for ten years or more. Most of the farm operators (21) owned their farms. Seven farm operators had operations of sufficient scale to be classed as commercial farms, 16 classified as part-time and the remaining four were simply "residential" farms according to the U. S. Census of Agriculture definitions of farms by economic class.[5]

Equally important to an appraisal of the effects of industrialization are the workers who are former farm operators. An additional 24 workers had operated a farm at some time during the preceding ten years. Of these 24, eight had owned their farms and the rest had been tenant operators.

Where do the plant workers live?

Industrial plant operations are governed by exacting time schedules for manufacturing processes and for the workers as well. Before rapid public transportation was available and private automobiles were common, factory workers had to live close to their places of work. In most rural communities, the private automobile offers the plant worker the only means through which he may remain on the farm or in the open country and commute to his place of employment. Choices concerning a place to live and the likelihood of changes in residence as a result of new job opportunities are important facts to all persons concerned with the implications of rural industrialization.

Places of residence of plant workers are compared with those of all open-country residents in the area in table 4. Two-fifths of the plant workers lived in Houston and other nearby towns. Almost a third lived on farms and the rest—a little over a third—lived in the open country but not on farms. Workers with school age children were distributed about evenly among farms, open-country nonfarm, and village residences, with slightly more living in villages.

Table 4. Distribution of Respondents by Residence, Chickasaw County, 1957.

Residence	106 Plant workers	317 Open-country residents
	Percent	Percent
Total	100	100
Farm	29	69
Open-country, nonfarm	31	30
Town or village	40	—
Not reported	—	1

Earnings of plant employees

Farm income and farm wages are relatively low in Chickasaw compared with many areas in Mississippi and with averages for the United States as a whole. One would expect wage rates in a newly established plant to be fairly close to the existing (nonfarm) rates in the local community. The prevailing wage in the plant was about $1.00 per hour. The majority of the workers, including all but three of the female workers, reported weekly earnings between $35 and $44 (table 5). Older workers, as a group, did not receive the highest weekly earnings. Workers

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[5] Residential farms are those with a value of farm products sold between $150 and $250 during the year.

Table 5. Distribution of Plant Workers by Weekly Earnings, Chickasaw County, 1957.

Weekly Earnings*	106 Plant workers
	Percent
Total	100
25 - 34	4
35 - 44	59
45 - 54	28
55 - 64	4
65 and over	4
Not reported	1

*All of the female workers earned between $35 and $54 per week.

Table 6. Classification of Residence According to Most Recent Move, Chickasaw County, 1957.

Type of Move (Most recent)	106 Plant workers	317 Open-country residents
	Percent	Percent
Total	100	100
To farm	26	25
To open-country, nonfarm	11	17
To town or village	33	—
No move in last 10 years	30	57
Always farm	4	44
Always open-country, nonfarm	20	13
Always town or village	6	—
Not reported	—	1

Table 7. Residence Classification Prior to Last Move, Chickasaw County, 1957.

Residence prior to last move	106 Plant workers	317 Open-country residents
	Percent	Percent
Total	100	100
Farm	23	28
Open-country, nonfarm	11	9
Town or village	36	5
No move in last 10 years	30	57
Not reported	—	1

aged 25-29 had the highest proportion earning more than $45 per week, about 59 percent. Only a little over a third of the workers over 35 years of age earned $45 or more per week.

Recent Changes in the Lives of the Plant Employees

The central objective of this study is to appraise the changes in a rural community wrought by the introduction of an industrial plant. In a final report, changes in the lives of plant employees will be compared with changes noted among a representative sample of residents of the rural community. In this report, changes among plant employees will be described. Only a few general comparisons to the open-country residents will be made.

Residential mobility

Over two-thirds of the plant employees had moved at least once during the preceding ten years; nearly three out of ten employees had made four or more moves. Setting aside for the moment the plant employees who reside in villages we find that only two in five of the plant workers who now live in the open country have not moved in the past ten years. The average open-country resident appears to be much less mobile, over half of the rural households sampled had not moved in a decade; only one in ten had moved four or more times.

Is the tendency of plant workers to be more mobile than a cross-section of rural residents in the same community associated with acceptance of industrial jobs? The survey data cannot answer this question directly but information on the coincidence of residential moves with job changes among the plant workers may provide additional light. Over one in five employees changed residences at the time they took a job in the factory. An additional 16 percent changed residences after taking their present job. However, two in every five workers moved before changing jobs and the rest (one in five) made no residential change.

Occupational mobility

A factory job involves a rather sharp departure from rural ways. Employees of a new industrial plant in a predominantly rural community would be expected to have exhibited a greater tendency to change jobs than the average rural resident in the area. Well over half of the open country residents had held the same job or made only one change of occupation in the last decade. In contrast, more than four out of every five plant workers had changed jobs at least twice in ten years and about 30 percent had changed jobs four or more times. Only about six out of a hundred open-country residents had held four or more jobs in the last ten years.

If the plant workers show a greater willingness (or ability) to change jobs, what are the implications of this tendency for the rural community as a source of industrial labor? Table 8 indicates that only one in five plant workers made the change directly from farm work to factory. A quarter of the workers came from other factory jobs and two-fifths from other nonfarm jobs. If most of the "all other" group are farm residents, about one third of the plant workforce made the jump from farm work directly to factory jobs. These findings are in line with those of a companion study recently completed in Louisiana[6], where it was found that about one-fifth of the occupational shifts made by employees of a rural industrial plant who were living on farms involved a direct shift from farm to factory.

Table 8. Distribution of Plant Workers According to Previous Job Held, Chickasaw County, 1957.

Previous job	106 Plant workers
	Percent
Total	100
Farm	20
Factory	25
Other nonfarm	41
All other (including first job)	14

Changes in levels of living

One of the central objectives of the Rural Development Program, inaugurated in 1954 by the U. S. Department of Agriculture, was the achievement of higher levels of living in low-income rural areas. It is generally assumed that the development of industry is one of the chief means to generate employment and raise incomes in depressed areas. Information was obtained in this study on the number of a list of household items possessed by the workers in 1950 and 1957. The items were electric lights, hot and cold running water, mechanical refrigerator, power washing machine, radio, television, telephone and automobile.

Table 9 compares the number of items the plant employees had in 1950 and 1957. One in every seven workers now employed at the plant possessed none of the listed items in 1950 and over half of the employees had three items or fewer in that year. By 1957, almost two out of three workers had six items or more and 15 percent possessed all eight items.

The period 1950-1957 was one of generally increasing prosperity throughout most of the United States. To obtain a better appraisal of the influence of the new plant on levels of living in the community, we should compare the rise in employee levels with those of a cross-section of the same rural community. Table 10 shows how the open-country residents fared in the period 1950-1957.

Almost one-quarter of the rural residents interviewed had none of the items on the list in 1950 and two thirds had three items or fewer. However, the proportion of households in the rural sample having six items or more in 1950 was not significantly different from the proportion of employee households with six or more in that year.

Table 9. Change in Levels of Living Among Plant Employees, 1950-1957, Chickasaw County, 1957.

Number of items possessed	106 Plant employees	
	1950	1957
	Percent	Percent
Total	100	100
1	16	—
2	12	1
3	15	3
4	24	6
5	11	27
6	5	27
7	1	21
8	2	15
None	14	—

Table 10. Socio-economic Status of Plant Workers and Open-country Residents, 1957.

Socio-economic status score* (Belcher)	106 Plant workers	317 Open-country residents
	Percent	Percent
Total	100	100
Under 25	2	18
25 - 34	24	33
35 - 44	61	32
45 and over	13	17

*Low score represents low socio-economic status and high score higher status.

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[6] **The Effects of Industrialization on Rural Louisiana: A Study of Plant Employees,** Price, Paul H.; Bertrand, Alvin L.; and Osborne, Harold W. Louisiana Agricultural Experiment Station, LSU, 1958.

By 1957, about 30 percent of the open-country households had six items or more, only about half the proportion of employees' households having that many. The greatest difference between the groups appears at the extremes. Every household in the employee sample reported at least two items in 1957; about ten percent of the open-country households were still without any of the facilities on the list in 1957, and about a fourth had two items or fewer. Clearly, the plant employees as a group enjoyed a substantially higher level of living than did a cross-section of rural families in the county, both in 1957 and in 1950. The average number of items possessed by plant employees rose from 2.9 in 1950 to 6.0. For rural residents in the community, the average number of level-of-living items increased from 2.5 to 3.9 between 1950 and 1957.

Plant employees ranked higher on the socio-economic status scale (table 10). Half of the open-country residents had scores under 35 in contrast with only one out of four of the plant workers. Higher scores among plant employees were associated with residence in or close to town and with greater occupational mobility.

One additional attempt to appraise the effect of industrial jobs on level of living was made through the use of a standard socio-economic status scale.[7] All households in the employee and open-country samples were assigned scores on the basis of certain standard items in and around the home, such as type and quality of house construction, articles of furniture and appliances, bathroom and fixtures and similar items. The higher the score achieved, the higher the socio-economic status of the household in so far as it can be measured by items on the scale.

Table 11. Change in Levels of Living Among Open-country Residents, 1950-1957, Chickasaw County, 1957.

Number of items possessed	317 Open-country Residents	
	1950	1957
	Percent	Percent
Total	100	100
1	19	8
2	12	6
3	10	8
4	9	15
5	15	17
6	7	19
7	3	11
8	—	1
None	24	9
Unclassified	1	6

Higher scores among plant employees were associated with residence in or close to town or village and with greater occupational mobility.

Income of plant employees and open-country residents

The average plant worker earned far more than the average rural resident in the area in 1956. One-half of the plant workers earned $3,000 or more in 1956 from all sources, including farms; only 13 percent of the open-country residents did as well (table 12). The middle income group among open-country residents was $1,000 - 1,999 but nearly two out of five reported total incomes of less than $500 in 1956.

Table 12. Total Family Income in 1956, Chickasaw County, 1957.

Total income, including farm income	106 Plant workers	317 Open-country residents
	Percent	Percent
Total	100	100
Less than $500	2	18
$ 500 - $ 999	8	14
$1,000 - $1,999	15	18
$2,000 - $2,999	25	9
$3,000 - $3,999	18	8
$4,000 - $4,999	19	3
$5,000 - $6,999	8	1
$7,000 and over	5	1
Unclassified	—	28

These findings appear to indicate that family incomes in rural communities are raised substantially through industrialization. However, information on plant workers classified by income and previous job held suggests that the process may be slow or that persons in the rural community taking factory (or other nonfarm) jobs tend to come from higher income groups within the community (table 13). Plant employees shifting from farm work had a median nonfarm income about $1,200 lower than workers who had transferred from another factory and $550 lower than those from other nonfarm jobs.

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[7] Sewell, William H., "A Short Form of the Family Socio-Economic Status Scale," **Rural Sociology**, VIII (1943), 161-169; and Belcher, John C., "Evaluation and Restandardization of Sewell's Socio-Economic Scale," **Rural Sociology**, XVI (1951), pp. 246-255.

Apparently some employees were able to take higher paying jobs in the factory because of skills learned at earlier industrial jobs. Whether we include family income from farm sources or consider nonfarm family income separately, plant workers who shifted from another factory job had a higher median income than workers who had shifted directly from farm jobs, or than workers who had shifted from other nonfarm jobs.

Table 13. Total and Nonfarm Family Income in 1956 of 106 Plant Employees by Last Occupation Held, Chickasaw County, 1957.

Last Occupation	Percent	Family income, 1956 (Median)*	
		Total	Nonfarm only
Total	100	——	——
Farm	20	$2,639	$2,298
Factory	25	$3,749	$3,500
Other nonfarm	41	$3,055	$2,953
All other (including first job held)	14	$1,874	$1,874

*Computed from grouped data.

Table 14. Attitude of Plant Workers and Rural Residents Toward Changes in "Chance to Get Ahead" in Recent Years, Chickasaw County, 1957.

Attitude toward chance to get ahead	106 Plant workers	317 Open-country residents
	Percent	Percent
Total	100	100
Same	22	35
Better	68	39
Worse	4	17
No opinion	6	9

Attitudes toward industrialization

Everyone reacts to changes in his customary ways of living. The coming of an industrial plant to a rural community would be expected to bring about rather sharp changes in the lives of many residents of the community and especially in the lives of persons taking jobs in the factory.

All persons interviewed were asked whether they thought the factory had helped the community. Practically all (97 percent) of the plant workers answered "yes" to this question, and most of these gave as a reason that the factory had brought more money and jobs to the community. As might be expected, open-country residents were less sure of the beneficial aspects of industrialization than were the plant workers. Nevertheless, over two-thirds of the sample of open-country residents believed the factory had helped the community by bringing more money and jobs to the area. Only about four percent thought that the factory had not helped the community and the remaining 25 percent had no opinion.

Workers were also asked for their comments on any change in economic opportunities within their community or "the chance to get ahead" within the last few years. In this case, feeling was more divided among both plant workers and open-country residents than in attitudes toward the factory. As before, more plant workers than open country residents could see a change for the better in possibilities for economic advancement in the community. The reverse was true among those who thought "a chance to get ahead" had worsened; 17 percent of the rural residents were of the opinion that economic opportunities were fewer now than a few years ago, while fewer than four percent of the plant workers were pessimistic about their chances to get ahead. Most of those in both groups who thought that economic opportunities had improved gave reasons based on industrial expansion: "more jobs and payrolls" or "industries have come in."

Changes in social activity

If an industrial plant introduces fundamental changes in the economy of a rural community, it could be expected to influence the community's social fabric as well. To appraise the effect of industrial work on rural residents, respondents were questioned concerning their present and past memberships in such organizations as churches, social clubs, fraternal groups, P. T. A., etc. Table 15 indicates that fewer than one out of five workers are taking a greater part in social activities now than before the plant was established and about two out of five reported no change. Changes in social participation of respondents in the open country sample are not significantly different from those of plant workers.

Looking at the extent of present participation in social activities highlights

Table 15. Changes in Participation in Organizations Among Plant Workers and Open Country Residents, Chickasaw County, 1957.

Type of Change	106 Plant workers	317 Open-country residents
	Percent	Percent
Total	100	100
Taking greater part	19	17
Taking less part	8	13
No change	39	41
No answer	34	29

Table 16. Distribution of Plant Employees by Farm Tenure, Chickasaw County, 1957.

Tenure classification	Plant employees	
	Now operating farms	Former farm operators
	Number	Number
Total	27	24
Full owner	21	8
Renter	6	15

some differences between the plant workers and the sample of open-country residents, however. Two in every five plant workers were not members of any organization compared with about seven percent of open-country residents. At the other extreme, over one in ten rural residents claimed membership in six organizations; only one in a hundred among plant workers had as many. However, over 60 percent of the plant workers were members of from one to three organizations compared to 50 percent of the open-country residents.

Very little difference was noted in the type of social participation reported by plant workers and rural residents, except that, somewhat surprisingly, a higher proportion of plant workers than rural residents reported active membership in religious organizations: 60 percent versus 51 percent. Church affiliated activities were the only social participation of one-half of the plant workers and about 43 percent of the open-country residents.

Farm operations

As was noted earlier, 27 plant employees were also operating farms at the time of the survey and another 24 had operated farms before taking a factory job. Table 16 shows the distribution of plant workers according to farm tenure. The number of cases is too small to support conclusions based on differences between present and former operators; however, the preponderance of owners among workers now operating farms and the opposite tendency among former operators suggests that the landlord-tenant relationship discourages off-farm work and invites instead a clean break with farm operations when off-farm work is undertaken by the farm tenant.

How extensive are the farm operations carried on by the plant workers? Only seven workers had farms which qualified as "commercial" under Census of Agriculture definitions: sale of products of $250 or more and income from farm greater than off-farm income. Most of the plant workers who had farms reported between $250 and $1,200 in value of products sold during 1956 but their nonfarm income exceeded income from sale of farm products. However, factory workers with farms appeared to be doing as well as a cross-section of farm operators in the area; one half of the farmers in the open-country sample reported value of products sold of under $1,200 in 1956.

This is not to say that all or even a large number of farm operators can take full-time factory jobs and continue farming as before. When questioned as to whether they had made any changes in their farm operations after taking a job in the plant, eight workers reported a decrease in acreage or other reductions in scale.

It is likely that many who have made no changes in their farm operations since taking a factory job may decide to cut down as they adjust to a new mode of living. When asked whether they intended to continue farming, only seven replied in the affirmative; in the sample of rural residents, nearly nine out of ten farm operators intended to stay on the farm. Perhaps opportunities for industrial employment tend to draw away from farming those who have the weakest attachment to agriculture, or factory experience tends to weaken farm ties and dependence on the farm for economic security. Rural persons with lesser attachment to agriculture tend to be younger, to be tenants rather than owners, and to be members of lower income farm families.

M69b

BULLETIN 567 OCTOBER, 1958

THE MARKET FOR LOCALLY-PRODUCED FOODS FOR FREEZING

By

DOROTHY DICKINS and VIRGINIA FERGUSON

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The Market For Locally-Produced Foods For Freezing

By

DOROTHY DICKINS and VIRGINIA FERGUSON

The frozen-food locker plant and the home freezer have motivated important changes in recent years in the movement of food products through the channels of trade from producers to consumers. Especially has this been true in areas without ready access to large grocery stores. Also, there are large segments of population with access to food surplus, either of their own seasonal production or from that available in their community, which can be frozen and held from the surplus season to a later date for consumption. We are aware that such a development has taken place and that considerable marketing activity has been developed to service it. We lack specific information on the present place such a development has as an outlet for locally-produced products.

It was the purpose of this study (1) to determine the kinds, sources, amounts and costs of foods stored in community lockers and in home freezers; (2) to ascertain the kinds of marketing services used and wanted, and methods of supplying these services more efficiently; and (3) to evaluate the contribution of frozen foods from the standpoint of money costs, time-saving, and improvements in diets.

SCOPE AND METHODS

Towns and cities representative of different types of farming areas in Mississippi were selected. These areas included widely varied enterprise combinations, such as truck crops and livestock in contrast to strictly non-food cash crop enterprises such as cotton. The areas selected were Corinth, Aberdeen, Hollandale, Indianola, Jackson, and Forest.

A list of locker and meat-curing plants in the six study areas was obtained and the manager in each plant interviewed with the use of a schedule during January-March, 1957. Managers were not only questioned about the use of local food products for freezing but were also asked for the names and addresses of families renting a locker and/or having a home freezer who had bought food in large quantities for freezing during the past year and about locker rental charges, services offered, packaging materials sold, and the like. Pretests with homemakers had shown that this latter information would be needed since some homemakers did not keep receipts of services and charges.

Home and County Agricultural Extension Agents furnished additional names of families having freezers and/or lockers who had purchased food in large quantities to store during the year preceding the interview (1956-57). "Large quantities" was defined as "halves or quarters of beef, large quantities of pork, poultry, fruit, etc., (over two weeks' supply)". A random sample of 259 names was drawn and homemakers in 208 of the families interviewed with the use of a schedule. Thirty two of the 51 families from whom data were not obtained were found to be ineligible when visited to interview; 11 families could not be contacted and 8 families would not or could not cooperate. Data were obtained from 104 families in the Jackson-Forest area; from 62 in the Aberdeen-Corinth area; and from 42 in the Hollandale-Indianola area.

One hundred and fifty-eight names of local farmers who had sold them food products for freezing were furnished by homemakers in the 208 families. A random sample of these including 51 were interviewed with the use of a schedule. Homemakers and farmers were interviewed during March-June, 1957.

DESCRIPTION OF FAMILIES

The study was limited to white families since there were so few Negro families using locker plant facilities. The 208 families had an average of 3.87 members. This means a larger size family than is the average for white families in the State. Thirty-nine per cent of these families had 3 members or less, 52 percent from 3.1 - 5.0 members and 9 percent more than 5 members. Family members included those pooling incomes and dependent upon the family funds for most of their support.[1]

The 208 families were for the most part high income families. Only 17 percent had had incomes of less than $4,000 during the year preceding the interview. Twenty-four percent had had incomes of $4,000 - 5,999; 32 percent of $6,000 - 9,999; and 27 percent of $10,000 and over, during this same period.

The main occupation of the principal earner in 52 percent of the families was proprietor, superintendent or professional service. In 20 percent of the families this occupation was white collar work (manager, clerk, or kindred worker); in 14 percent skilled or semi-skilled wage work; and in 8 percent, farm operation. In two percent of the families about the same amount had been received from farm operation as non-farm work and both occupations were listed as the main occupation.[2] Four percent of the families included lived from pensions and/or investments.

In 23 percent of the families the homemaker had had gainful work during the past year. The occupation of 15 percent of these women was classified as white collar work (usually clerical work); 6 percent as proprietor, superintendent, or professional work (usually professional work); and 2 percent as semi-skilled or skilled wage work.

Homemakers in 85 percent of the families had had high school education or more. Of this percentage 31 percent had finished high school only, 26 percent had had some college training and 28 percent had completed college.

The homemaker in one-fourth of the families was under 35 years of age; in about two-thirds of the families she was under 45 years of age. Only 4 percent of the homemakers were 65 years and over.

The 208 families who bought food "in large quantities" to put in their locker and/or freezer were therefore families with somewhat more members, families of relatively high income, and with homemakers of above average education. The majority of the homemakers in these families had attended college. Two-thirds of them were under 45 years of age. The characteristics of families who buy food in quantities for freezing is important background information for future development of this market.

FREEZING FACILITIES—USE AND SATISFACTIONS

To have been included in the study the family must have rented a freezer-locker or have owned a home freezer part or all of the past year. No family was included whose only frozen storage space was a freezing compartment in a refrigerator. But data concerning use of refrigerator freezer compartments by the 208 families were obtained when the compartment had been used to store foods for periods of over two days during the past year.

The percent of families using freezer facilities of specified kinds was as follows:

	Percent
Freezer only	38
Freezer and refrigerator	28
Locker and refrigerator	13
Freezer and locker	11
Locker, freezer, refrigerator	6
Locker only	4

---

[1] Homemakers were asked about the number of meals usually served in their house durin a week in summertime and wintertime. The equivalent household size in winter and in summer was calculated by dividing the number of meals served in the household during the week by 21. The average household size was in winter 3.77 persons and in summer 4.00 persons.

[2] Twenty-three percent of the families operated farms.

The majority of families with incomes of $6,000 or over as well as those with incomes of under $6,000 had the use of a home freezer but not of a locker. The percentage of the higher income group having home freezers only was 63; of the lower income group, 70. Higher income families, however, more often had both freezer and locker. Twenty percent of the higher and 12 percent of the lower had both facilities.

Fifty percent of the 208 families had more than 15 cubic feet of freezing space. Twenty percent had more than 20 cubic feet. There were fewer higher income families ($6,000 and over) with freezer space of less than 10 cubic feet than lower income families (under $6,000), but the same percentage in both income groups had more than 20 cubic feet of freezing space. Freezing space includes that in freezers, lockers, and/or compartments of refrigerators.

Home Freezers

Home freezers were owned by 172 of the 208 families included. One home freezer was owned by 165 families; two home freezers by 6 families; and four home freezers by one family. Nine percent of the home freezers had been owned less than 2 years, and 4 percent more than 10 years. The greatest number (41 percent) had been owned from 4-6 years. About three-fourths had been owned less than 7 years.

Eighty-two percent of the home freezers owned by the 208 families included were of the chest type; the remainder were of the upright type.[3] These families owned 27 different brands of chests and 15 different brands of upright freezers.

Homemakers with home freezers were asked about the increase in the electric bill since owning a freezer (1) during the months when freezing food, and (2) during other months. They were also asked about cost of repairs on freezers during the past year. Sixty five percent of the homemakers interviewed stated that the increase in the electric bill in the months during freezing was none or not noticeable; 85 percent, that the increase in other months was none or not noticeable. Twenty-nine percent of the homemakers stated that there was an increase in months during freezing and 10 percent stated that there was an increase in other months.[4] The remainder replied "Don't know" to these questions. Only 26 homemakers would state an amount per month increase during freezing; only 5, an amount of increase during other times. The former group most often named amounts of $.51 - $1.00; the latter group, amounts of 50 cents or under. Only 8 percent of the 172 families owning home freezers had had expenditures for repairs during the past year. Three families (2 percent) had had repair bills of $25 or more; the remaining of lower amounts.

Amounts which families had paid for freezers owned ranged from $75 to $800 with an average of about $370. A number of the freezers were purchased wholesale; a few were purchased second hand; four were gifts. These 181 freezers ranged in size from 5 cubic feet to 32 cubic feet with an average of slightly over 14 cubic feet.

At the time of the study (Spring and early Summer), 2 families (one percent) had nothing in their freezer; 11 percent had their freezer one-fourth or less full. Thirty two percent had their freezer from 26-50 percent full; 34 percent, from 51-75 percent full; 13 percent, from 76-99 percent full; and 10 percent, full.

Homemakers reported that during the past year their freezers had been full of food for the following number of months:

Number Months	**Freezers Full*** Percent
None	11
1 or 2	11
3 or 4	17
5 or 6	20
7 or 8	11
9 or 10	13
11 or 12	17

*Includes the 4 percent who had owned freezers less than one year.

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[3] No one had a built-in freezer.

[4] According to the home management specialist in Rural Electrification of the Mississippi Agricultural Extension Service, the electric bill is increased very litte when a freezer is added. Only the more observant women would notice a difference.

Only about one family in eight said their freezer had been full 12 months during the past year. According to estimates made by scientists[5] in the U.S.D.A., costs per pound of food in home freezer storage is less than one-half with a turn-over of 150 percent as compared with no turn-over. All costs except those for packaging and freezing food remain the same regardless of the quantity of food in the freezer.

Foods In Home Freezers Longest Time: Maximum Amounts Put in at One Time: Information was obtained on foods left in the freezer for the longest period of time, and maximum amounts of unfrozen food put in the freezer at one time. Long storage periods or raising temperature of the freezer such as by adding large amounts of unfrozen food at one time lower the quality of the frozen product and probably reduces willingness to buy for frozen storage. The way food is handled before freezing, the packaging material used, storage temperature and kind of food all affect the length of time that a frozen product will keep without loss of quality and flavor. Only limited research has been done as to maximum time different foods should be kept. Specialists in this area, however, have "opinions" and "recommendations."

Homemakers were asked to name the foods now in their freezer the longest time and the length of time; also, to state the longest period of time a food has ever been left in the freezer, name of the food, and taste and color of this food when removed. Storage periods of these foods were compared with approximate good quality maintenance storage life at zero degrees Fahrenheit of foods compiled by Dr. Earl C. McCracken of the Institute of Home Economics, Agricultural Research Service of the U. S. Department of Agriculture and other specialists.[6]

Forty-three percent of the foods reported as in the freezer now the longest time had been in longer than the time recommended. Sixty-six percent of the foods reported as the longest time **ever** in the freezer had been in a longer time than was recommended. In both cases it was a vegetable that was reported as in the freezer the longest time. (See Tables 1 and 2 in Appendix A for a summary of these foods with recommended time of storage and the time stored). It must be kept in mind that these two questions were designed to get at **maximum** storage periods in freezers. More than half the foods named as now in storage the longest period of time had been in storage the recommended time or less. About one-third of the foods that represented the longest storage **ever** were in the recommended time or less.

The question might well be asked how the women rated foods they named as in the freezer the longest period ever left in. The majority of these foods were rated as satisfactory. There was, however, some difference in foods rated as satisfactory left in longer than recommended time and left in recommended time or less. Seventy-one percent of the former and 83 percent of the latter were so rated. Opinions of "experts" and homemakers would seem often to disagree. It is significant for the market that families liked frozen foods so well that homemakers gave high ratings even to products left longest ever in their freezers.

The homemakers reported that the largest amount of unfrozen food they had put in the freezer at one time was:

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[5] Home Freezers, Their Selection and Care; U.S.D.A. Home and Garden Bull. No. 48, 1956, page 3, Washington.

[6] Some data were obtained from "Freezing and Using," Ohio Agricultural Extension Service Bull. No. 369, Jan. 1958; and "Freezing Fruits, Vegetables and Meats," New Jersey Extension Bull. 294, May 1956. In a report to be published by the Federal Extension Service prepared in cooperation with the University of Massachusetts, some of the storage times differ from those on our list. However, the list of storage times finally used were sent to Dr. McCracken just before publication of this report for further checking. He called and visited around for the latest information and opinions of those who should know most about approximate good quality maintenance storage life of the foods on our list when stored at zero.

Pounds	Homemakers Reporting Percent
4-19	23
20-39	26
40-59	21
60-99	16
100-360	14

About two-thirds of the foods reported as put in the freezer unfrozen in quantities of over 50 pounds was meat, poultry, and fish; about one-third fruits and vegetables. The Home Management Specialist in Rural Electrification of the Mississippi Agricultural Extension Service recommends that not more unfrozen food be put in the freezer at one time than one-tenth of the capacity of the freezer. She states also that one-fifteenth is a preferable figure. The amounts reported by 27 percent were larger than the recommended minimum. It would seem important, especially for those with small home freezers, to have meat frozen before putting in their freezer. It is more often meat that is put in the freezer in large quantities at one time.

Advantages of and Complaints About Home Freezers: All homemakers were asked, "What would you say are the advantages of a home freezer? Do you have any problems or complaints in connection with your home freezer?" Many advantages and few complaints were given. The advantages named were as follows:

Advantages	Percent giving*
Convenient	91
Saves time and effort	67
Economical, saves money	61
Better quality food, more balanced meals	51
Provides storage space for food	42

*Most gave more than one advantage.

Some examples of these comments are: "Food on hand when need"; "Makes serving company meals a pleasure"; "Can put small amounts in at one time"; "Saves cooking time"; "Bake pies ahead"; "Do cooking on Saturday for the following week"; "Can buy in large quantity and save money"; "More nutritious meals"; "More balanced meals"; "Better vegetables"; "A place to store foods".

There were 34 homemakers interviewed who had both a home freezer and a community locker while 138 had a freezer and no locker. Replies of these two groups as to the advantages of owning a freezer were compared. The women who had both facilities more often mentioned "saves time and effort" and "provides storage space for food" as advantages of the home freezer. Those with a freezer only more often mentioned the other three advantages.

Only 26 complaints or problems with the home freezer were reported. Six women said their freezers were not large enough; one complained that her chest type took up too much space in the kitchen; five complained about defrosting; five gave complaints about the machine such as, noisy, freezer goes off, interferes with listening to T.V. Other complaints involved the difficulty of finding food in the chest type; complaints about food and other things, such as "Frozen ham doesn't have as good taste as fresh", "Family doesn't like frozen peaches", "No delivery of frozen foods where we live".

Community Lockers

Community lockers were rented by 70 of the 208 families included. One locker was rented by 55 families; 13 families rented two lockers and two families rented three lockers. Twenty percent of the families had rented a locker less than one year. This included some families who rented by the month or to provide for a temporary overflow. Thirty-six percent had rented lockers less than two years, 14 percent more than 10 years. About one-fourth had rented their lockers from 2 to 4 years and one-fourth from 4 to 11 years. Maximum space rented during the year ranged from 3½ to 15 cubic feet with an average of about 7 cubic feet. The average yearly rental paid for locker space was about $15.00.

Each homemaker was asked about the distance from her home to the locker plant, the frequency of going to the locker plant and facilities for getting there. Two-thirds of the interviewees lived less than 2 miles from the locker plant. Only 4 percent lived more than 10 miles away. Eighteen miles was the farthest distance traveled to the plant.

All 70 families renting lockers owned an automobile or truck. The auto or truck was available for going to the locker plant in the morning hours in 86 percent of the families. Sixty-one of the 70 homemakers could drive an auto.

In 57 percent of these families the wife usually went to the locker plant; in 31 percent, the husband; in 9 percent, the wife and/or the husband; and in 3 percent another member of the family. The locker plant was ordinarily visited once a week in 54 percent of the families, more often in 16 percent, two or three times a month in 10 percent, and less often in the remainder. The six frozen food locker plants in the communities studied were open six days in the week from 9 to 14 hours per day except during the summer months when they were closed one afternoon a week. One plant offered delivery service within city limits of wholesale items only, such as cases of frozen orange juice, frozen butterbeans.

At the time of the study 8 of the 70 families renting lockers had no food in their locker. These included seven families not renting a locker at this particular time. Twelve percent of the families had some food in the locker, but lockers were not more than one-fourth full. Thirty-three percent had their lockers from 26-50 percent full; 19 percent, from 51-75 percent full; 11 percent, from 56-99 percent full; and 14 percent had them full.

Fifty-six (or 80 percent) of the 70 families using lockers during the report year had rented them all year. These 56 women reported that during the past year their lockers had been full of food for the following number of months:

Number of months	Locker full Percent
None	2
1 or 2	14
3 or 4	23
5 or 6	18
7 or 8	5
9 or 10	16
11 or 12	22

About one family in eight said their locker or lockers had been full during all the past 12 months. This is the same percentage as reported for freezers. Neither facility was being used to the maximum.

Foods in Locker Longest Time: Families less often kept foods in lockers more than the recommended time than in home freezers. This seems related to the fact that the locker is used more for frozen meat storage.[7] Fruits and vegetables are more likely to be kept longer than the recommended time than is meat.

Twenty-four percent of the foods named as in the locker the longest time had been there longer than recommendations for freezer storage at zero degrees Fahrenheit. Forty-nine percent of the foods reported as the longest time ever in the locker had been in a longer time than recommended. (See Tables 3 and 4 in Appendix A for a summary of these foods with recommended time of storage and the time stored).

The taste and color of only 8 percent of the foods in locker storage the recommended time or less was rated as not satisfactory. The percentage of food so rated in such storage longer than recommended time was 31 or four times as great.

Advantages of and Complaints About Lockers: Homemakers were questioned about the advantages of renting a locker and problems or complaints regarding its use. The advantages (some homemakers gave more than one) reported were as follows:

Advantages*	Percent giving
Economical, saves money	44
Provides storage space (or additional storage space) for food	44
Convenient	26
Better quality of food; more balanced meals	17
Saves time and effort	10

*Two mentioned the fact that the food in a locker was insured and the locker plant was responsible for spoilage.

The comments given regarding the advantages of the locker were similar to those given regarding the freezer, but the percentages giving replies of the various types differed. For example, fewer spoke of the locker being convenient and of time and effort saved than in case of the home freezer. Forty-two percent of the 36 families with a locker and no home freezer said an advantage of the locker was convenience, but only 9 percent with both locker and home freezer gave this as an advantage of a locker.

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[7] Another factor is that one can discontinue renting a locker, but the home freezer is already purchased and a part of one's regular equipment.

Only 11 complaints of the locker were given. The most (six) were complaints about food, mainly meat processed at the plant. These included: locker plant puts too much fat in hamburger; meat wasn't clean; meat sometimes not as good as other times; too much bone in beef; hamburger has a stale taste; off flavor. The second type of complaint (four) related to the inconvenience of keeping food at the locker plant. These were: don't like to go after the food; away from home; hard to get foods home. One woman mentioned the narrow aisles at the locker plant and the ladder being hard to move.

Refrigerators

Two hundred and five of the 208 families had an electric refrigerator. One of these also had a gas refrigerator. Two of the other three had a gas refrigerator and one a kerosene refrigerator. Ninety-eight families (47 percent) said that during the past year they had stored foods for more than 2 days in the freezing compartment of their refrigerator.

One-third (32 percent) of the refrigerators used for such storage had been owned 2 years or less; 5 percent had been owned for more than 10 years. Thirty-four percent had been owned from 2.1 - 6 years and 29 percent from 6.1 - 10 years. There were 15 different brands of refrigerators used for frozen food storage.

Eight of the 98 families storing food longer than 2 days in the freezing compartment of their refrigerator had refrigerators with an ice cube section only, the remaining had an additional freezing space in the refrigerators. The space used for frozen foods in refrigerators ranged from .5 to 4.0 cubic feet with an average of 1.8 cubic feet.

The freezing space or compartment in 44 percent of these refrigerators was insulated. The insulation ranged from a thickness of .5 to 4.0 inch averaging 2.6 inches. Twenty-nine percent of the 98 refrigerators used for frozen foods had separate doors to their freezing compartments.

In pretesting the schedule to use in this study, it was found that refrigerator compartments varied widely as to temperatures. There seemed no simple method for determining whether the freezing compartment of the refrigerator was a zero degrees Fahrenheit one. Therefore, interviewers were instructed that if the homemaker stored food in the freezing compartment of her refrigerator (one of the first questions asked in the schedule) to tell her that you would like to place a thermometer in this space until the end of the interview. The interviewer was instructed to do this herself placing a freezer thermometer on the bottom of the freezer unit. She was asked to read the thermometer at the end of the interview immediately after opening the refrigerator door with thermometer still in the bottom of the freezing unit. It was assumed that home freezers and lockers had a temperature of 0°F or less and temperatures of these were not taken.

Eight refrigerators were not at their usual setting at the time of taking the temperatures. The temperatures of these refrigerators were warmer than usual. All were above zero. Several of these refrigerators were being defrosted. There was no report as to whether the setting was usual or not in case of five refrigerators. This means that there is information about temperatures of freezing compartments from 85 refrigerators. Sixty-nine of these refrigerators were above zero degrees Fahrenheit ranging from one degree to 26 degrees above zero with an average of 11 degrees above zero. Eleven were at zero degrees and five were below zero ranging from 1 to 12 degrees below zero, averaging 5.8 degrees below.

Foods in Refrigerators Longest Time: Foods **in** and **ever in** the freezing compartments of refrigerators longest were classified according to temperature of the compartment—(1) above zero, and (2) zero and below. Recommended storage time was regarded for above-zero-temperature-refrigerators as two weeks or less.[8] For zero or below zero refrigerators the same storage periods recommended for freezers and lockers were used.

The percentage of foods now stored or ever stored longest whose storage period exceeded time recommended was as follows:

	Storage longer than recommended
Food now in refrigerator longest	
Refrigerator above 0°F	Percent
Food put in frozen	39
Food put in not frozen	50
Refrigerator zero or below zero	
Food put in frozen	0
Food put in not frozen	0
Longest period food ever in refrigerator	
Refrigerator above 0°F	
Food put in frozen	55
Food put in not frozen	62
Refrigerator zero or below zero	
Food put in frozen	0
Food put in not frozen	20

From the foregoing summary it would seem that families using refrigerators with zero or below zero degree freezing compartments followed quite well recommendations as to length of storage. This was a small group, however. Only 19 percent of the freezing compartments had such low temperatures. Also, all 16 families in this group owned a home freezer and/or rented a locker.

It is the family with the freezing compartment of the refrigerator above zero temperature who puts food in unfrozen as well as frozen who might need assistance. In the discussion of foods now stored in the refrigerator to follow later, it is shown that most of the food in the refrigerator had been put there in quantities to last 2 weeks or less. It is important, however, to know that there were so many of the families who stored "large amounts" of food in refrigerators of above zero temperatures.

How Frozen Storage Areas Used— When More Than One

Fifty eight percent of the families used more than one freezer storage area (See summary on page 6). The homemakers in these families were asked to explain how the different freezing areas were used.

Those using a home freezer and a freezing compartment of a refrigerator reported that the main bulk of food was frozen in the freezer and stored there. Such things as leftovers from the freezer (i.e. several chops from a package of chops), small items left over from meals, foods bought from the grocery store, were stored in the refrigerator freezing compartment. Several mentioned using the refrigerator for ice cream and juices since they did not get as hard as in a freezer.

Those using a locker and a freezing compartment of a refrigerator reported that food was frozen in the locker and a week or two week's supply brought from the locker to the refrigerator. Also, that the freezing compartment of the refrigerator was used to store food from the grocery as ice cream, juice, frozen vegetables.

The homemaker in families with both freezer and locker usually reported that the meat and chicken was stored in the locker and when there was room in the freezer brought home and stored there. Vegetables were stored in the freezer when the family had both facilities.

When the family had all three facilities they usually stored the overflow meat and chicken in the locker, vegetables in the freezer. A small supply of meat and chicken were kept in the freezer. The refrigerator compartment was used for leftovers, small items, and specials from the grocery.

Families with more than one freezer or more than one locker did not all follow the same use pattern. The most common pattern, however, was to store one type of food in one and another type of food in the other as, for example, meats in one, vegetables in another. Another pattern often followed was to put the food in the freezer or locker where there was the most room. A few filled one facility, then another.

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[8] In 1946 Ruth Ellen Mackley in a Masters thesis at Iowa State College studied the effect of storage temperature and time on the palatability of frozen fruits and vegetables. The temperature involved in storage was 20°F. Changes varied with foods. Changes were noted in peaches in two weeks; broccoli was not affected in 6 weeks. Other foods studied fell between these limits.

KINDS, QUANTITIES, SOURCES AND COSTS OF FROZEN FOODS IN LOCKERS, FREEZERS, AND REFRIGERATORS

Homemakers interviewed were asked about (1) foods put in lockers and home freezers in quantities to last over two weeks during the past year, and (2) about foods now stored in freezer and/or refrigerator whether put in during the past year or previously. Quantities stored during past year were limited to those stored in amounts to last more than two weeks since homemakers could not be expected to recall small amounts put in storage throughout the **year.**

During the past year the 208 families included had stored in lockers and/or home freezers in quantities to last over two weeks an average of 782 pounds of food. The amounts stored ranged from 77 to 5804 pounds. One high income family had stored this latter large amount. The average amount stored per person per family was 214 pounds.

More homemakers reported amounts of from 400-799 pounds of food put in freezer and/or locker during the past year than any other. These amounts were:

Amounts stored in freezer and/or lockers past year* Lbs.	**Percent of families**
Less than 400	28
400 - 799	37
800 - 1199	16
1200 and over	19

*These amounts were derived by taking each individual item listed and converting it into pounds (if not reported that way) and obtaining a total for all foods stored.

The amount stored was related to the income of the family and the amount of freezing space (see Figures 1 and 2). Twenty-five percent with incomes of $6,000 and over and 10 percent with incomes of under $6,000 had put 1200 or more pounds of food in the freezer and/or locker during the past year.

In Table 9 in the Appendix the amounts of the various kinds of foods stored by families classified by income are given. Relatively more of the highest income ($10,000 and over) than the lowest income (under $4,000) families stored such things as other poultry (turkey, duck, geese), commercially-frozen ice cream, commercially-frozen fruit, commercially-frozen vegetables, commercially-frozen juices and ready-prepared food. But relatively more of the lowest income group stored pork, butter, and fresh fruits and juices. (See Appendix B for the classification of food used in this study).

Families with incomes of under $4,000 reported an average of 701 pounds of frozen food stored during the report year; those with incomes of $10,000 or more, an average of 1125 pounds. Fifty-nine percent of the total poundage of the lower income group and 58 percent of the higher income group included meat, poultry, fish and game.

The cubic feet of freezing space was a more limiting factor than was low income. Families with less than 10 cubic feet of such space put in this freezing storage during the report year an average of 389 pounds of food, 73 percent of which was meat, poultry, fish and/or game. Families with more than 20 cubic feet of frozen storage space put into freezing storage during this same period an average of 1238 pounds of food, 55 percent of which was meat, poultry, fish and/or game.

Relatively more families with 20.1 and over cubic feet of frozen food storage space had stored food of every type during the report year than families with less than 10 cubic feet of such space (See Table 10 of the Appendix). Greatest differences in percentage storing were, however, in pork, fryers and hens, other poultry, fish, commercially-frozen ice cream, fresh fruits and juices, commercially-frozen fruits and juices, fresh vegetables, nuts, and ready prepared foods. (See Table 10 in Appendix A).

Source of Foods Put in Freezer Storage

Eighty-two percent of the families purchased more than 50 percent of the total amount of food they had stored in lockers and/or home freezers during the report year. More than one-half the families (58 percent) purchased more than 75 percent of it. Fourteen percent of the families purchased all food they had stored during this period.

The percentage of the total amount of food stored which had been purchased was related to family income. Families with more income had purchased relatively more of the food they had put in frozen storage during the past year. (See Figure 3).

Families with more freezing space depended relatively less on purchase than those with less freezing space. (See Figure 4). Families with more

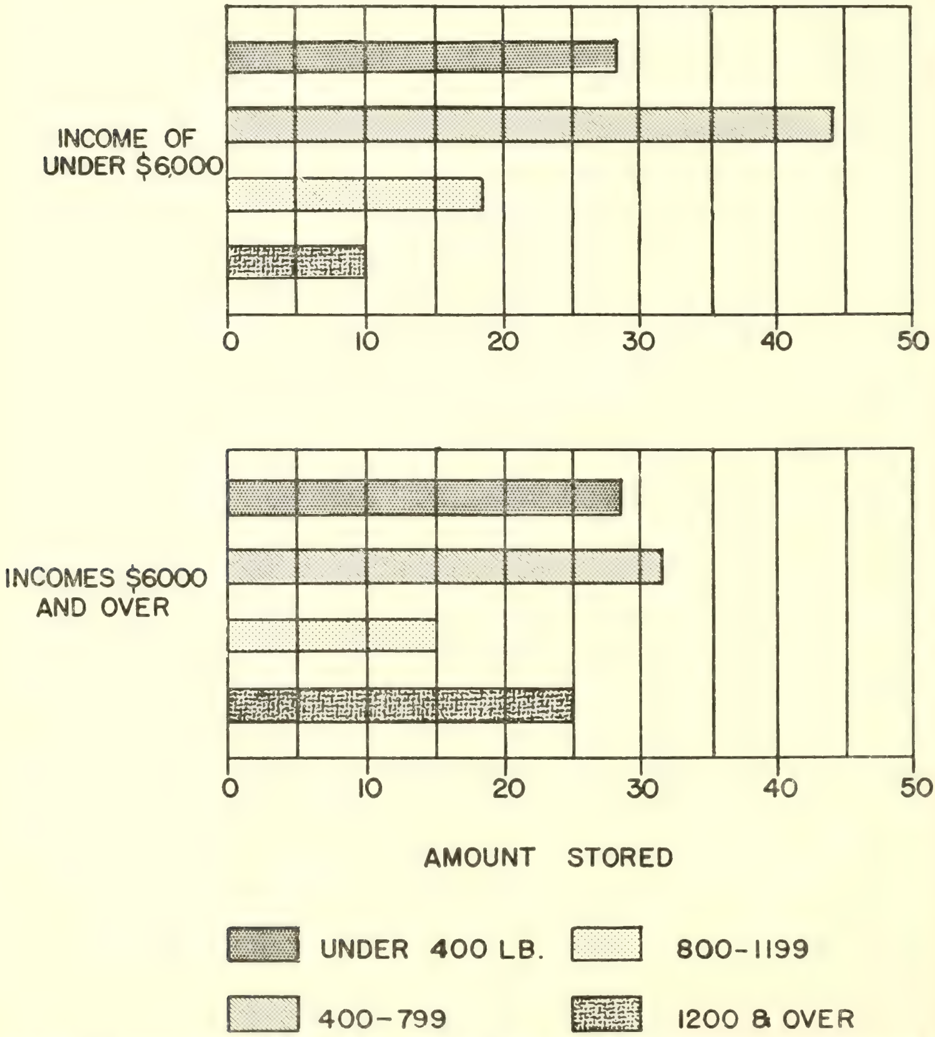

Figure 1. Amounts stored during the past year in freezers and/or lockers by families with income under $6,000 and with incomes of $6,000 and over.

freezing space more often put in foods obtained from fields, woods, lakes, or streams such as fish and game; also, more often put in home-produced vegetables.

Sources of specified foods stored by one-fifth or more of the families (See Table 11 in Appendix A) might be summarized as follows:

	Percent families storing
Purchased food	
Beef and veal	84
Fryers, hens	67
Fresh fruits and juices	54
Fresh vegetables	42
Commercially-frozen ice cream	25
Pork	25
Shellfish	23
Ready-prepared foods	23
Home-produced food*	
Fresh vegetables	46
Fish	29

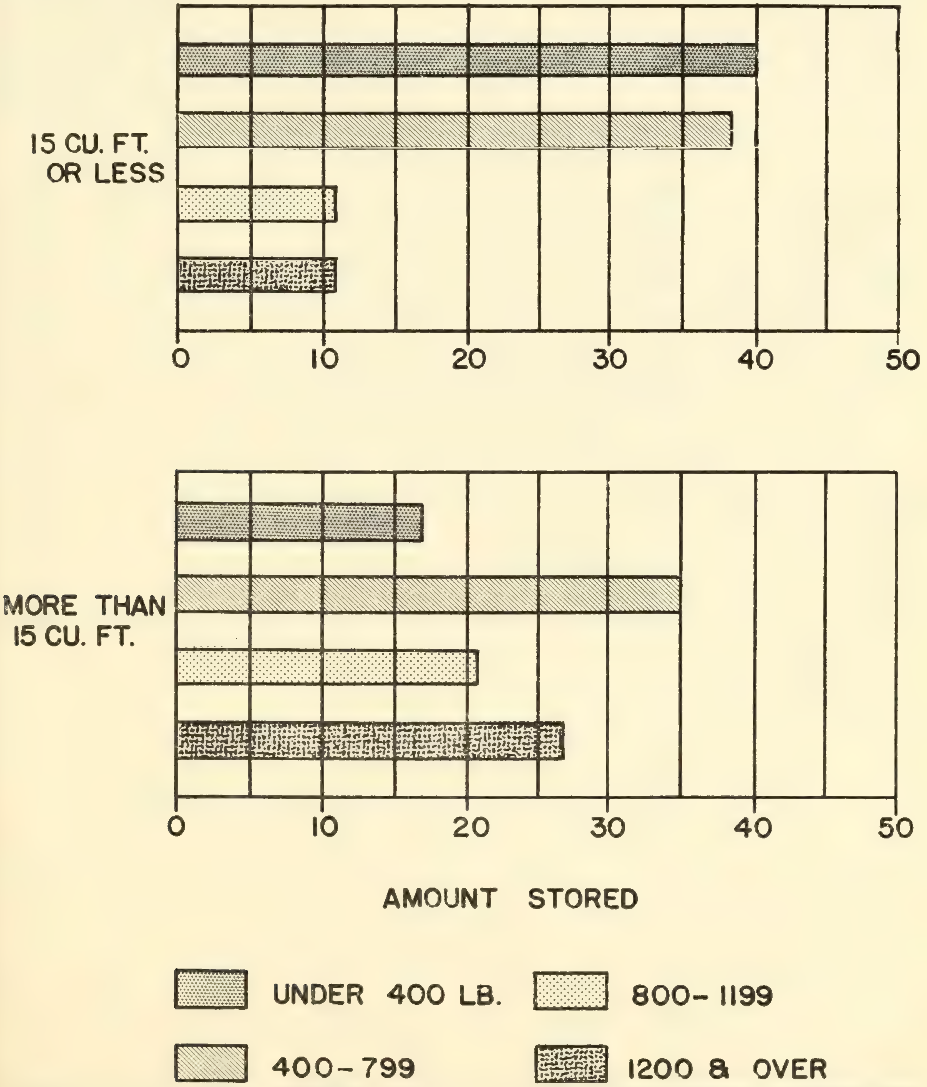

Figure 2. Amounts stored during the past year in freezers and/or lockers by families with 15 cubic feet or less of freezing space and by families with more than 15 cubic feet of freezing space.

Fresh fruits & juices	26
Game	24
Gifts of food	
Nuts	24
Fresh vegetables	23

*Includes foods produced at home or obtained from fields, woods, lakes, or streams.

Ready-prepared purchased food included for the most part bakery products such as bread, rolls, buns, pies (meat, poultry, and fruit), and cakes. (See Table 12 in Appendix A).

When the food stored was purchased the homemaker was asked from whom it was bought. Sources of purchase included (1) locker plants; (2) producers and peddlers; (3) retailers; (4) farmers markets; (5) processors and wholesalers; and (6) food plans. Producers and peddlers had to be classified together since in a few cases the interviewee did not know whether or not the fruit or vegetable was produced by the seller. Food purchased from fishermen, berry-pickers, truckers, were all classified in the second category. Retailers included food purchased from grocery stores, fish markets, and other retail businesses. Farmers markets included not only farmers and home demonstration club markets, but also cattle barns and

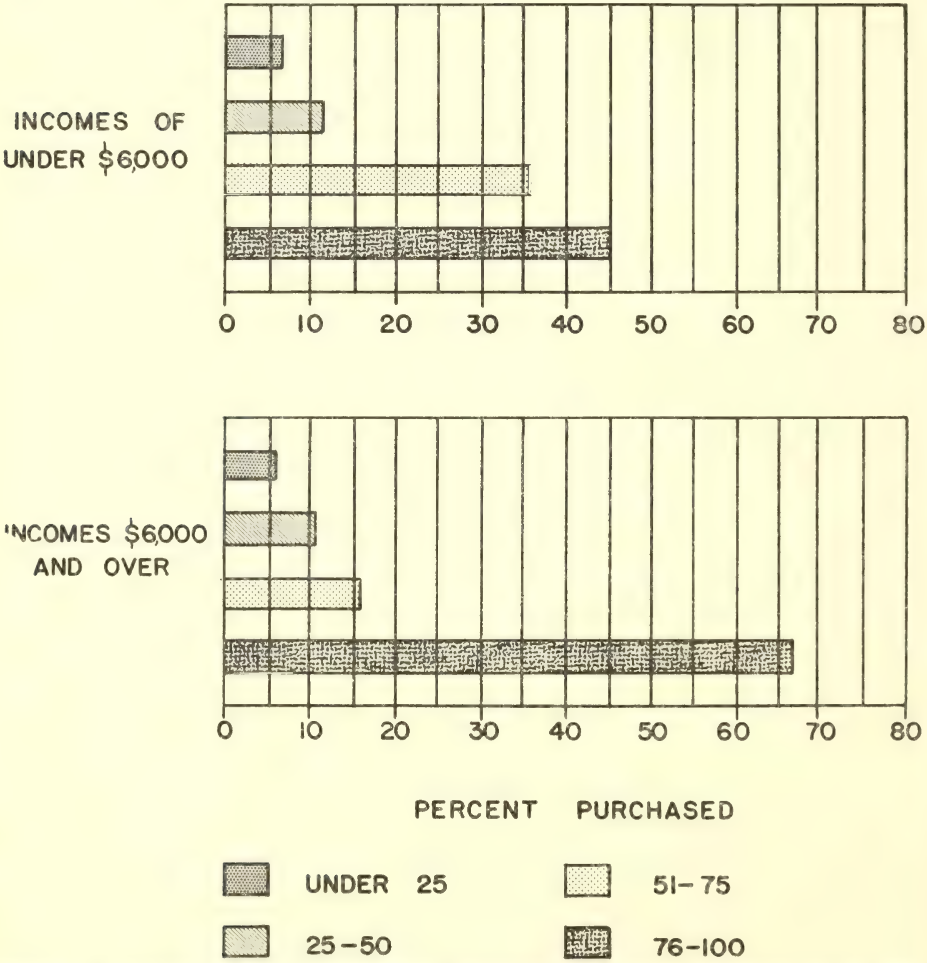

Figure 3. Percentage of the total amount of purchased food stored in freezers and/or lockers by families with incomes under $6,000, and with incomes of $6,000 and over.

livestock shows (two purchased animals belonging to 4 H Club members displayed at livestock shows). Processors and wholesalers included such things as meat purchased from packing houses, ice cream purchased from creameries, chicken from processing plants.

Of those families who bought food to put in the locker and/or home freezer, what percentage bought it from locker plants, producers and peddlers, retailers. This percentage[9] varied widely according to product as is shown in the table below:

Where families bought food

Source of purchase	Beef and veal Percent	Fryers and hens Percent	Fresh fruits, juices Percent	Fresh vegetables Percent
Locker plants	38	9	0	0
Producers and peddlers	27	24	78	69
Retailers	19	54	15	4
Farmers markets	4	0	12	30
Processors, wholesalers	21	21	2	0
Food plans	2	1	0	0

Of those buying beef and veal, and fryers and hens, from producers and peddlers, all purchased from producers rather than peddlers. But of those buying fruit and vegetables from producers and peddlers 61 percent buying fruit and 79 percent buying vegetables bought from producers; 54 percent buying fruit and 30 percent buying vegetables bought from peddlers.[10]

In Table 13 in the Appendix A not only is the percentage of families storing purchased foods of various kinds from different sources (locker plants, producers and peddlers, etc.) given, but also the total amounts purchased and average cost per family buying. Families buying spent most for beef and veal no matter what the source of purchase. They also bought more pounds of beef and veal for freezing than other kinds of food except from retailers. Here total quantity purchased was highest for fryers and hens and ready-prepared foods.

Satisfactions With Purchases of Food for Freezing

The products which the homemaker reported as purchased and put into home freezers and/or lockers during the past year were listed and the homemaker asked about each, "Considering the time, expense, and quality, was buying a good idea? Why or why not? Any problems or complaints? Would you buy again?"

Most of the purchases of food made to put in freezers and/or lockers were reported by homemakers as a good idea (See Table 14 in Appendix A). Reasons most often given were convenience; saves time and trouble; economical; food was good—it kept well. Some typical comments were: wouldn't be without supply; saves trips to town; less trouble, cheaper; saved money; delicious; better than canned; keeps well; keeps over 6 months.

Only a few homemakers reported that buying the foods was not a good idea (See Table 15 in Appendix A). The most frequent reasons given were "not economical" and "food not good." Some typical replies were: no money saved; too much waste; too much bone or brisket; food not good; canned food better; got rancid before used it all; turned dark.

The 208 homemakers stated that 55 of the food buys (about 6 percent) were not a good idea. But for only 21 of these buys did they state they would not buy again. The majority, it would seem, were hopeful of making a more successful buy next time. Eleven of the 21 foods they would not buy again were purchased at the locker plant, 5 at the grocery store, 2 from a farmer, two at a livestock barn and one in connection with a food plan. More involved meat, poultry, and fish than fruit and vegetables.

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[9] Adds up to more than 100 percent since some families bought a food from more than one source.

[10] In the peddler group are included a few persons for whom it was not known whether or not they had produced the food they offered for sale.

Processing and Wrapping

In reporting processing services, homemakers gave information about who performed these services (See Table 16 in Appendix A for information concerning who got specified foods ready for freezing). Listed below is the source most often mentioned for getting food ready for freezing and the percentage of homemakers mentioning:

Foods	Source most often mentioned for getting food ready for freezing	Percentage Homemakers mentioning
Beef and veal	Locker plant	63
Pork	Locker plant	46
Lamb & mutton	Locker plant	60
Luncheon meat	No or little preparation	100
Fryers, hens	No or little preparation	70
Other poultry	No or little preparation	62
Fish	Family prepares	79
Shellfish	No or little preparation	79
Game	Family prepares	92
Butter, cream, milk, cheese and eggs	Family prepares	76
Oleo	No or little preparation	100
Commercially-frozen ice cream	No or little preparation	100
Fresh fruit and juices	Family prepares	99
Commercially-frozen fruits	No or little preparation	100
Commercially-frozen juices	No or little preparation	100
Fresh vegetables	Family prepares	99
Commercially-frozen vegetables	No or little preparation	100
Nuts	Family prepares	79
Home-prepared foods	Family prepares	100
Ready-prepared foods	No or little preparation	100

Under "no or little preparation" were foods that were put in frozen storage wrapped as when purchased. Included in this category are also some foods which the family members wrapped but performed no other service.

Twelve families out of the 208 reporting had had no experience in preparing and packaging food for freezing. This leaves a total of 196 who had had such experience. Homemakers in these 196 families stated that they had obtained information about processing and wrapping from the following sources:

Source	Percent obtaining information*
Booklet that came with freezer	69
Home Economists (especially Home Demonstration Agents)	17
Friends	14
Mass media (magazines, bulletins, pamphlets and cookbooks)	13
Locker plant personnel	8
Relatives and family members	7
Club meetings and cooking schools	5
Other	4

*Some gave 2 or 3 sources.

Most of the cash expenditures for processing services by the family involved meat and poultry. (See Table 17 in Appendix A for percentage of families storing bought, home-produced and gifts of foods and having expenses for processing and other service charges and average expense per family having such expense). Service for beef and veal included slaughtering, chilling, cutting, grinding, wrapping, freezing. Services for pork included slaughtering, curing, smoking, chilling, cutting, grinding, wrapping, freezing, rendering lard. Services for lamb were similar to those for beef. Services for fryers and hens and for other poultry included killing, dressing, wrapping and freezing. When the family paid a flat sum for the product also processed for storing, no attempt was made to determine expense for processing separate from that paid for the product.

The percentage of families having expenses for such services and average amount spent by those having the expense was:

Food	Percent families storing specified food reporting processing costs	Average amount reported by those reporting processing expenses (dollars)
Beef and veal	72	16.27
Pork	41	12.31
Mutton	40	5.31
Fryers and hens	12	2.30
Other poultry	13	2.34
Fish	4	4.36
Game	15	2.50
Fresh vegetables	1	5.08

The kind of packaging material used varied widely from one type of food to another (See Table 18 in Appendix A). For beef, pork, and lamb, freeze paper and tape was the most common.

Lunch meat and ready-prepared foods (cakes, breads, and the like) were usually put into frozen storage as they came wrapped from the store, in cellophane or waxed paper. (Wax paper is not suitable for it is neither vapor nor moisture proof, an important requirement for packaging for freezing). For fryers and other poultry, the plastic bag was about as popular as freeze paper and tape. Shellfish were usually deposited in the freezer as brought from the store, in the paper box covered with wax paper. For fish (usually caught in nearby streams by a family member) freeze paper and tape were used. Freeze paper was the most usual wrapping for game as well as for fish.

For fresh fruits and vegetables the plastic bag was most often used; for home-prepared foods, aluminum foil. The milk carton, the use of which is

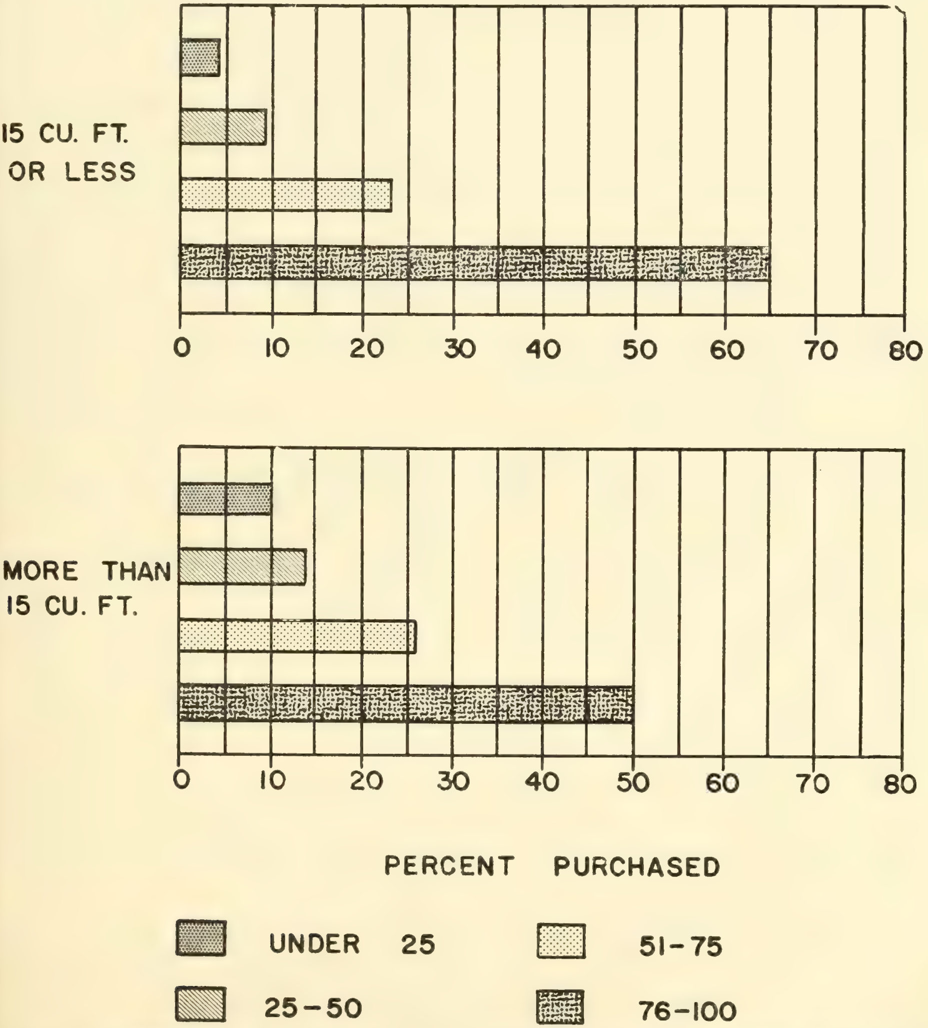

Figure 4. Percentage of the total amount of purchased food stored in freezers and/or lockers by families with 15 cubic feet or less of freezing space and by families with more than 15 cubic feet of freezing space.

usually frowned on by food specialists since it is difficult to sterilize such cartons, was seldom used. Its use was most common in fresh fruits where 8 percent of the families freezing reported its use.

Homemakers interviewed were asked to report packaging materials and other freezing supplies bought the past year. Plastic bags were by far the most common packaging material purchased. Seventy one percent of the families had purchased these during the year with an average expense of $3.34. Thirty percent had purchased freeze paper, 24 percent aluminum foil, and 17 percent freeze tape. Total expenditures by these 208 families were most for plastic bags, next for aluminum foil, then plastic containers and fourth for freeze paper. (See Table 19 in Appendix A for families buying and expenditures for packaging material).

Homemakers were asked two opinion-type questions concerning processing and packaging: (1) Do you have any problems or complaints concerning the processing, packaging of foods for freezing or the preparation of frozen foods? (2) Are there any services in connection with your frozen food supply not now available which you would like to have and be willing to pay for?

Only 32 homemakers said they had any problems or complaints concerning the processing and packaging of foods for freezing or the preparing of frozen foods. These problems or complaints were for the most part related to preparation of vegetables and fruits, which foods the family members usually prepare for freezing. Two women complained about freezing supplies—the plastic bags were not strong enough to re use and additional caps for glass freeze jars could not be found. Three complained about blanching vegetables. They did not want to blanch vegetables. There were 21 complaints about freezing specific vegetables. Most of these involved either string beans or corn. One woman complained because fruit could not be frozen satisfactorily without sugar. She had a diebetic in the family. Nine complained about specific fruits—5 of these about peaches. Other complaints about food included 3 about chicken (it turns dark around the bone), 2 about eggs, and one about bacon.

Only 10 homemakers mentioned services and materials in connection with the frozen food supply not now available to them which they would like and be willing to pay for. These included a food plan; good brown wrapping paper like the locker plant uses; service for shelling beans and peas; a locker plant that would process vegetables; a locker plant that would deliver frozen foods.

Frozen Food Now Stored in Home Freezers and Refrigerators

Homemakers were asked not only about food put in freezers and/or locker during the past year but also about the foods in freezers and freezing compartments of refrigerators at the time of the interview, location before being placed into freezer or refrigerator, whether it had been placed in freezer or refrigerator in small amounts (amounts to last 2 weeks or less) and whether it was frozen or not when put in freezer storage.

Fifty-two percent of the food items brought to the home freezer from the grocery store and 79 percent from the family table had been placed in the freezer in small quantities. Foods in the freezer from other sources had originally been stored in large quantities. Ninety-five percent from the family farm, yard, woods or streams; 94 percent of those purchased from places other than the grocery store including farmers, locker plants, wholesalers, etc.; 88 percent of those brought from the family's rented locker; and 88 percent of the gifts had been stored in over two weeks supply. (See Table 20 in Appendix A for classification of foods in home freezers at the time of the interview).

From the foregoing summary it would seem that most foods placed in home freezers are in quantities to last more than two weeks. The actual percentage of food items in home freezers at the time of the interview which had been placed in these freezers in such amounts was 70. Furthermore, nine-tenths of the food items to last two weeks or less were brought to the freezer from the grocery store or family table. Total amounts stored in large quantities would therefore furnish a good basis for evaluation on the potential market for farmers.

Most of the food in home freezers at the time of the interview had been put into these freezers unfrozen. The exceptions are foods from rented lockers and grocery stores which were usually frozen when placed in freezers. To be noted is the fact that 8 percent of the food items from the locker were thawed at the time of placing them in the freezer. The percentage of foods listed which were put into freezer unfrozen by source of food before it was placed in the freezer was as follows:

Source of food before placed in freezer	**Percent of total food items in freezers that had been put into freezer unfrozen**
Grocery	47
Other places of purchase	58
Family table*	98
Rented locker	8
Family farm, yard, woods, streams**	92
Gifts	82

*Includes food mixtures prepared ahead for future use.

**Includes some meat and fish frozen at locker plant.

Most of the food no matter the source of it before being placed in the freezing compartment of the refrigerator had been placed in the refrigerator to last 2 weeks or less. (See Table 21 of Appendix A). All foods brought to the refrigerator from the garden, yard, woods, or streams and 97 percent from the family table were put into the freezing compartment of the refrigerator unfrozen. But foods put in the refrigerator from other sources were generally frozen when put in.

This means that freezing compartments of refrigerators were used for more temporary storage and less for freezing foods than were home freezers. About 30 percent of the foods reported in freezers at the time of interview and 60 percent in freezing compartments of refrigerators at this time were brought to the freezer from the grocery store.

BUYING FOOD AND OTHER ARRANGEMENTS MADE BY LOCKER PLANTS FOR CUSTOMERS

The manager of each locker plant was asked three questions about buying food and other arrangements made for customers: (1) "During the past year have you bought any products from local farmers and cattle barns for resale? If yes, kinds, amounts, arrangements with farmers, customers and advantages and disadvantages;" (2) "During the past year have you ordered any products from packing houses, seafood houses, or other wholesalers for sale to families for freezer storage; and if yes, kinds, amounts, arrangements with wholesalers, customers, and advantages and disadvantages;" (3) "During the past year have you processed any products which were bought locally and if yes, kinds, amounts, whether sales arranged by locker plant or not and comments concerning same."

Three of the locker plants of the study were operated in conjunction with small packing plants and one in conjunction with a retail grocery store. Much of the produce on which these managers reported was bought in connection with these enterprises and not for resale to families for freezing.

Four of the six plant managers stated they had bought beef cattle; four, hogs; two, fryers; two, hens; one, turkeys; and one, peas from local farmers or cattle barns.[11] Three managers stated they bought by order only. Two sent out buyers to look at beef cattle, but two others expressed a preference for buying at the cattle barn. They said it saved time, that it was easier to get what you wanted at the cattle barn since there was more selection. There was no difficulty in loading at the cattle barn, no injuries to cattle from loading; that farmers often thought they had "choice" beef when it was "commercial." Farmers ask more on the farm than they could get at the cattle barn. One plant buying 85,000 fryers had a contract with the farmer.

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[11] Some information was obtained in addition from a packing house in Aberdeen which performed processing services for families and rented a few lockers.

The six plant managers reported 1650 head of cattle, 1004 hogs, 147,400 fryers, 45 turkeys, 675 hens, and 1,000 pounds of peas bought from farmers and/or cattle barns during the past year. Most of the beef graded "commercial"; some graded "good".

There were also some locker plants buying from meat and poultry packing houses, seafood houses, and from other wholesalers for resale. Most of this buying, however, was by order requiring cash payment, and much of it was for sale to retailers, cafes, and the like; not to families. One hundred and sixty-five halves of beef, 525 fryers, 1500 hams, 3500 pounds of bacon, and 3200 pounds of sausage were reported as ordered from wholesalers and packing houses. Other foods reported as ordered from such sources were fish, cheese, oleo, bologna, and frankfurters.

FARMERS MARKETS

There were two farmers markets in areas surveyed. These were the farmers market in Jackson used by about 1500 producers during a season; and a small home demonstration club market at Corinth with six producers. Forty-two percent of the families included in the Jackson sample had purchased during the report year one or more food products in large quantities to put in their lockers and/or home freezers from this farmers market in Jackson. Only one of the 31 families included in the Corinth sample reported buying food in such quantities during the past year to store in home freezers or lockers from the home demonstration club market. It seems very likely that some homemakers purchasing in these markets reported the name of the particular farm woman or farmer from whom purchased rather than of the market itself when asked for the name and address from whom they had bought.

SELLING FOOD FOR FREEZING BY FARMERS

The farmers from whom the families had purchased food in large quantities for freezing were asked about the amounts and kinds of foods they had sold during the past year for freezing. The 51 farmers interviewed reported selling 29,086 pounds of beef and veal, 3160 bushels of peaches, 2250 pounds of pork, 1759 dozen ears of corn, 1592 quarts of strawberries, 329 turkeys, 335 hens, 293 bushels of field peas, 265 fryers, 175 bushels of butterbeans, 112 bushels of string beans, 106 bushels of okra, and a number of other foods in small amounts for freezing.

The three kinds of food sold for freezing by most farmers (26 percent by each) were beef and veal, field peas, and butterbeans. Next in importance were corn, string beans, peaches, hens, okra, strawberries, and turkeys.

These farmers reported that one half or more of the total sold of the following foods was sold to put in home freezers and/or lockers: beef and veal, pork, fryers, hens, strawberries, other berries, butterbeans, string beans, field peas, English peas, corn, okra, and squash.

Farmers were asked to make comments, note problems and difficulties in connection with the sale of food for home freezers and/or lockers. The most frequent type of comment made was "good market", "could sell more", "sell all I can produce", "have regular customers". The type of comments next in importance concerned competition from truckers and/or out-of-state farmers: "they sell cheaper, destroy our market". Next there were a number mentioning "surplus produced, flooded markets". Other comments varied widely. Some of these were "no profit, grocery stores can sell cheaper", "people prefer to buy other ways, from locker plants or retailers", "raise for wholesale, sell to accommodate a few friends", "need for farmers exchange, need organized market", "quality of my products aren't so good".

EVALUATION OF THE MARKET FOR LOCALLY-PRODUCED FOODS FOR FREEZING

At the end of schedules used in interviewing homemakers, locker plant managers, and farmers, one or more questions were included which were aimed at getting an evaluation from the interviewee as to their opinion concerning the market for locally-produced foods for freezing.

By Homemakers

One of the questions asked the homemaker in this connection was: "If a steady supply of meats, poultry, vegetables, and fruits were to be available during the next 12 months, would you be interested in buying any of the following in quantities large enough for over two weeks storage in your freezer and/or locker? If no, why not? If yes, total quantity you would buy during the year, from whom you would prefer to buy, and why?"

The percentage of homemakers who reported that they would be interested in buying a steady supply of specified foods was as follows:

Foods	Percent
Beef	81
Fryers	73
Fruits	64
Vegetables	49
Hens	26
Pork	17
Lamb	9

Fryers, fruits, hens, and vegetables were the kinds of foods which more homemakers said they would buy for freezer storage than had bought for this purpose during the past year.[12] Slightly fewer said they would buy pork and beef than had purchased the past year. Average amounts named by those who would buy beef were smaller than average amounts of purchased beef stored during the past year, but average amounts of pork named were larger. (See Table 11 and 22 in Appendix A). Field peas, butterbeans, string beans and corn were the vegetables; peaches and strawberries, the fruits, named by more homemakers as those they would be interested in buying to store in freezers (See Table 22 in Appendix).

When homemakers were asked where they wanted to buy these foods, the largest percentages chose the following places. (See Table 23 in Appendix A).

For	Two most frequent places named
Beef and veal	Locker plant and farmer
Pork	Locker plant and farmer
Lamb	Locker plant and grocery store
Fryers	Grocery store and farmer
Hens	Grocery store and farmer
Vegetables	Farmers and farmers markets
Fruits	Farmers and farmers markets

Reasons most often given for wanting to buy in the specified place were (1) good quality of the food—its freshness; and (2) cheaper, can save money. (See Table 24 in Appendix A).

The three reasons most often given by homemakers for not being interested in buying specified foods in quantities large enough for over two weeks storage in home freezers and lockers were: (1) Produce own or receive as gift; (2) prefer other types or forms of food; don't use so much of this frozen food; (3) prefer to buy as needed in small amounts. The first reason was most important for beef and vegetables; the second reason for pork, lamb, hens and fruits; and the third for fryers. (See Table 25 in Appendix A).

All homemakers were asked if there had been any difference in kind and quality of foods their family eats since they have had a home freezer and/or locker. Seventy percent of the women replied "Yes" to this question and 27 percent said "No".[13]

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[12] During the past year 84 percent had purchased beef, 63 percent fryers, 54 percent fruits, 42 percent vegetables, 18 percent hens, 25 percent pork and 5 percent lamb for freezer storage.

[13] Three percent could not remember or had always had a freezer or had it too short a time to tell the difference.

The 144 women who said there was a difference in quality and kind of food since they had had a locker and/or home freezer gave 252 reasons or explanations. Fifty-four percent said the biggest difference was in more kinds of meat and a better quality of meat. Fifty-three percent made a general statement that covered all food such as "quality and variety of food is greater". Sixteen percent mentioned the fact that since freezing was economical they could have more kinds and better quality of food at the same price. Ten percent of the women spoke of better quality vegetables. Six percent stated that the family diet was more balanced, that they could do a better job of meal-planning.

Of the 56 homemakers stating there was no difference in kind and quality of food since getting a home freezer and/or renting a locker, only 34 (60 percent) gave an explanation. Most of these said they had the same kinds and qualities of foods except now they were frozen. Formerly they were canned. A few women said they did not like frozen food much. Some said they got tired of frozen food.

Ninety-four percent of the 208 families included had had frozen food facilities two years or more, but no family had had such facilities longer than 20 years. One-half the families had the facilities 6 years or less, one-half 7 years or more.

The market for locally-produced foods, if it is to be of assistance to the farmer, must be something he can count on. Not here today, gone tomorrow. If large numbers of families are willing to commit themselves to buying specified amounts then farmers can make plans for production of those amounts. A question was included in the family schedule to determine to what extent families were willing to make such commitments. This question was, "The Brown family has a large home freezer but because they live in town they must buy all the food they put into it. The locker plant in the town where the Browns live is offering top quality beef, pork, poultry, and all varieties of vegetables and fruits packaged, frozen and delivered at considerably less than the price Mrs. Brown has been paying. But in order to get this reduction she must buy at least $150 worth of food. She can have this financed through the local bank and pay in installments at 6% interest. Mr. Brown has a good position. If you were Mrs. Brown what would you do? (a) Keep on buying as you had been doing; (b) Arrange to buy the $150 worth on the installment plan; (c) or what?" Sixty percent of the women said they would buy as had been buying; 39 percent that they would accept the proposition (arrange to buy on installment) and one percent were undecided. Of those who said they would accept the proposition, 73 percent mentioned money-saving, 27 percent the convenience, and 4 percent that it would be easier not to have to prepare the food for freezing.

About two-thirds of those who wanted to keep on as they had been buying objected to buying food by installment.[14] About one-fifth of the women stated they would rather buy as needed. Reasons given were "family is small", "we produce a lot", "we don't stay long in one place". One-sixth of the homemakers said they liked their system of watching for specials. Another sixth doubted they would save if they had to pay interest on installments. Other reasons for keeping on buying as they had been were: present system saves money; might have to take food family did not like; hate to change.

By Locker Plant Managers

To better judge the locker plant managers opinion as to the market for locally-produced food for freezing the following question was asked: "Suppose that there are one or more of your county's best farmers who want to find a new market for some of their products. These men can be depended on for a steady supply of products. As a locker plant operator would you be interested in buying from these farmers any of the following for processing and/or resale during the next 12 months?" The manager was then questioned about particular kinds of foods, weight and size desired, total quantity during the 12 months, arrangements they prefer with farmers, whether would pay current market price and how they would sell to customers (cash and carry, food plans, services).

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[14] But the installment plan is generaly used in purchasing semi-durable and durable goods. In a recent study of white families in Mississippi, 81 percent of the homemakers in these families said they had made one or more installment payments during the past year. (See Money Practices and Attitudes of Rural Children and Parents. Mississippi Agr. Exp. Sta. Circular 209, July, 1957).

One plant manager said he would take 1,000 head of beef cattle weighing from 400 to 600 pounds each. He would be willing to pay current price. He stated the town was too small for arrangements with consumers, that he would sell to grocers. Another locker plant manager would take commercial grade beef cattle to sell to the packing plant. Another would be willing to take a few cattle graded "choice". He stated they would be "good", however, not "choice". Most locker plant managers said they preferred to buy beef at the cattle barn.

Two managers said they would like to buy hogs for processing and/or resale during the next 12 months. One mentioned 360 animals, the other 300 weighing from 200 to 220 pounds each. One of these said he would consider a contract with a farmer since it is easier to buy pork this way than beef. The other expressed preference for buying from the cattle barn. Both would pay current market price and sell to retailers. One manager unwilling to buy hogs for processing explained that he could not compete with the packing house which uses all parts of the animal.

No manager was interested in buying lamb.

Three managers expressed interest in buying fryers, but one by order only. One already had a contract with a poultry farmer for 85,000 birds but would take 100,000 birds weighing 2¾ to 3 pounds each during the coming year. The other would take 83,000 including a third more than he purchased the previous year. Two managers had discontinued processing poultry. They explained that the commercial broiler industry had through large volume made it possible for most people to buy dressed broilers cheaper than they could raise their own and have them processed. They stated grocery stores could sell broilers cheaper than locker plants could buy them.

Four locker plant managers said they were interested in buying hens; one wanted 5,000 weighing from 5½ to 7 pounds each. He said he would consider a contract with a farmer who could furnish the amount wanted. He was willing to pay market price. The number of hens mentioned by the other three locker plant managers ranged from 400 to 1300. One specified caged hens only.

Only one manager was interested in buying turkeys. Reasons given for not being interested were that turkeys are used at Thanksgiving and Christmas only; can't get double-breasted turkeys, the kind people prefer; grocery stores have good quality real cheap. Five of the six locker plant managers expressed themselves as not interested in buying from farmers such things as vegetables, fruits, nuts, and eggs. Only two of these plants processed vegetables and fruits.

The locker plant managers, however, mentioned certain services they were planning to provide. Two were planning to invest in a bean sheller. One was planning to offer a food plan to customers and another delivery of frozen foods.

By Farmers

To find out what farmers thought of the market for locally-produced food for freezing, they were asked, "Should agricultural agents encourage farmers to produce food to be sold for home freezers and lockers? Explain reply". Forty of the 51 farmers interviewed replied **Yes**; 9 replied **No**; and 2 were uncertain.

Reasons given why farmers should be encouraged to produce for the market were: (1) The market is here; the number of home freezers are increasing every year; not enough food to supply the demand; more and more town people buying fruits and vegetables for freezing. (2) Help increase incomes of farm families; provide another source of income for farm families. (3) Social reasons—help two families at one time and the community; help non-farmers have better food at lower cost. Many of the farmers who thought that agricultural agencies should encourage production for frozen storage emphasized the need for farmers to work together to organize markets that would bring together buyers and sellers.

In explaining a "no" reply, farmers usually remarked that encouraging production was not the first step, that farmers markets need to be established to put them in touch with buyers. One farmer said "unless the farmer has a contract with a buyer, production is useless". Another said, "Need to get families in the community to trade with farmers instead of meat packers".

Other reasons given for not encouraging farmers to produce for this frozen food market were "not enough profit to make worthwhile"; "competition of produce brought in from out-of-state"; "present over-supply of foods produced".

SUMMARY AND IMPLICATIONS

The purpose of this study was (1) to determine the kinds, sources, amounts and costs of foods stored in community lockers and in home freezers; (2) to ascertain the kinds of marketing services used and wanted, and methods of supplying these services more efficiently, and (3) to evaluate the contribution of frozen foods from the standpoint of money costs, time saving, and improvements in diets.

Data were obtained from 208 white families renting community lockers or owning home freezers who bought foods for freezing in large quantities, from managers of 6 locker plants, and from 51 farmers who sold foods to families for freezing. The families included were somewhat larger, had higher incomes, and the homemakers had more schooling than the typical census family of the State. Twenty-three percent of the group operated farms, but farming was the main occupation for only 8 percent. The main occupation of the majority (52 percent) was proprietor, superintendent, or professional worker. Homemakers in 23 percent of the families had had gainful work during the year preceding the study.

One hundred and seventy-two of the families owned home freezers, 70 rented community lockers, and 98 had freezing compartments to refrigerators which they used to store food for more than 2 days. Fifty percent of the families had more than 15 cubic feet of freezing space; 20 percent, more than 20 cubic feet of freezing space.

Four out of 10 families had had their home freezers full only one-fourth or less time during the previous year. This was likewise the case with those renting lockers. When asked to report the largest amount of unfrozen food put into the home freezer at one time, 27 percent of the women interviewed named amounts larger than the recommended minimum for the size of their freezing unit. About two-thirds of the pounds of food reported as put in the freezer unfrozen in quantities of over 50 pounds was meat, poultry, and fish; about one-third fruits and vegetables.

Forty-three percent of the foods in the home freezer and 24 percent in the locker "now in the longest time" had been in longer than suggested by specialists. Sixty-six percent of the foods named as having been stored in home freezers "the longest time ever" and 49 percent named as having been stored in the lockers "the longest time ever" had been in longer than suggested by specialists. The majority of the foods reported as in storage "the longest time ever" (both those with storage periods within suggested time and exceeding suggested time) were rated by homemakers as satisfactory in color and taste when removed from storage.

The advantages of owning home freezers most often given by homemakers were (1) convenience and (2) saving of time and effort. Advantages of renting lockers most often given were (1) saves money and (2) provides storage space. Only 26 complaints or problems with home freezers, and only 11 with lockers, were given by homemakers.

Temperatures were taken in freezing compartments of refrigerators used for storing food more than 2 days. Temperatures of 81 percent of the compartments for which such data were obtained were above zero, 13 percent zero, and 6 percent below zero. Most of the foods in such freezing compartments at the time of the interview had been placed in these compartments for periods of 2 weeks or less.

The 208 families stored in large quantities (in amounts to last over two weeks) in lockers and home freezers during the report year an average of 782 pounds of food. These amounts stored ranged from 77 to 5804 pounds.

Cubic feet of freezing space was a more limiting factor than income. Families with less than 10 cubic feet of freezing space put in this freezing storage during the report year an average of 389 pounds of food, 73 percent of which was meat, poultry and game. Families with more than 20 cubic feet of frozen storage space put into freezer storage during this same period an average of 1238 pounds of food, 55 percent of which was meat, poultry, fish and game.

Eighty-two percent of the families included in the survey purchased more than 50 percent of the total amount of food they had stored in large quantities in lockers and home freezers during the year. Fourteen percent of the families purchased all such food they had stored during this period. More than one-half the families had purchased beef and veal, fryers and hens, and fruits for freezer storage during the past year. Forty-two percent had purchased vegetables for this purpose.

The principal source of purchase of beef and veal was the locker plant; of fryers and hens, the grocery store; of fruits and vegetables, the farmer. Most homemakers, when asked whether or not the particular purchases she had made for freezer storage was a good idea, replied "Yes".

The source most often mentioned for getting meat ready for freezing was the locker plant. Family members (including servants and relatives) were most frequently reported as getting fish, game, eggs, dairy products, fruits, vegetables, nuts, and home-prepared foods ready for freezing. Other foods were most often put into freezer storage as they were purchased. The booklet that came with the home freezer was the most used source of information on preparing and packaging food for freezing.

Plastic bags were the most common packaging material purchased during the year preceding the interview (71 percent had purchased.)

Only 32 homemakers said they had any problems or complaints concerning processing and packaging of foods for freezing. These problems or complaints were for the most part related to preparation of vegetables and fruits which foods the family members usually prepare for freezing.

Locker plant managers had bought meat and poultry from farmers during the past year. The largest quantities, however, were purchased at cattle barns and under contract with a particular farmer.

Forty-two percent of the families included in the Jackson sample reported buying food in large quantities from the farmers market in Jackson to store in freezers. The three kinds of foods reported by the farmers as most often sold for freezing were: beef and veal, field peas, and butterbeans. Next in importance were corn, string beans, peaches, hens, okra, strawberries and turkeys.

Eighty-one percent of the homemakers said they would be interested in buying beef in quantities during the next 12 months for freezer storage; 73 percent, fryers; 64 percent, fruits; 49 percent, vegetables; 26 percent, hens; and 17 percent, pork. Fryers, fruits, hens, and vegetables were the kinds of foods which more homemakers said they would buy for freezer storage than they bought for this purpose during the past year. Field peas, butterbeans, string beans, and corn were the vegetables; peaches and strawberries the fruits named by more homemakers. When homemakers were asked where they wanted to buy these foods, farmers were given an especially high rating for vegetables and fruits.

Seventy percent of the interviewees said there was a difference in the kinds and quality of foods their family eats since they have a home freezer or locker. Most felt they had better quality and greater variety of foods than before having freezer facilities.

Thirty-nine percent of the homemakers said that **if** they could get good quality meat and a variety of vegetables and fruits at considerably less than they are paying—by ordering through the locker plant at least $150 worth of food financed by a local bank in installments at 6% interest, they would buy this way. Seventy-three percent gave as their reason the money saving and 27 percent the convenience. Four percent mentioned not having to prepare foods for freezing.

Locker plant managers were asked if they would be willing to buy specified foods from farmers (the best farmers who could be counted on to furnish a steady supply) for processing or resale during the next 12 months. Several expressed an interest in buying beef, pork and poultry. All six managers with one exception expressed themselves as not interested in buying from farmers such things as vegetables, fruits, nuts, and eggs.

When farmers were asked if agricultural agents should encourage them to produce food to be sold for home freezers and lockers, 40 of the 51 farmers replied "Yes". Many of these farmers as well as those who replied "No" emphasized the need for an organized market which would bring together buyers and sellers.

There are some implications in this study for producers and processors as well as for homemakers and home economists.

Some of the implications for producers and processors are: (1) There is a market for foods to put in freezer storage, principally among town and city families of higher income, larger families, and families with homemakers having more schooling. To these families the convenience and time-saving aspects of the freezer are very important. (2) Homemakers for the most part want processing services for meat and poultry performed by a marketing agency. These services take special skills and equipment. Fruits and vegetables are the kinds of foods they most often say they would like to buy directly from farmers. If the farmer is to receive full benefit from this market for food to put in freezer storage there must be local processors who will handle meat and poultry as well as farmers markets which will bring together buyers and farmers. It is important to integrate production, processing, and marketing of food products for freezer storage. Integration of processes will bring about economies that will benefit all groups. (3) Processors might well note that about one-third of the homemakers expressed an interest in a food plan. Money-saving and convenience features were reasons most often given for such an interest. Processors or others should investigate carefully these reasons before starting a plan. To be noted is the fact that relatively few families in our sample used a food plan. (4) Producers and processors should inquire as to the capacity of freezer storage before selling large quantities of food to a family to put in their home freezer. Excessive amounts put in unfrozen at one time lowers the quality of food. Sooner or later a market built on such a basis will be adversely affected.

Some implications in this study for homemakers and home economists are: (1) Homemakers should give more attention to obtaining maximum use of freezing facilities. Freezers and lockers kept full only one-fourth or less time during a year are not being used economically. (2) More stress should be made concerning the maximum amounts of unfrozen foods which should be placed into a freezer at one time. When it is necessary for homemakers to freeze large amounts for which they have insufficient facilities, they should take advantage of the services of commercial freezing concerns such as locker plants. (3) Home economists and homemakers should make further investigation of methods in which freezer storage may be used as a time-saver with emphasis on dishes which may or may not be satisfactorily prepared ahead and frozen. (4) More attention to keeping a record of the date when the food was put into storage. Freezing is a relatively new method of food preservation and some people are satisfied with foods in storage excessive periods now just as they used to be with tomatoes cooked by the open kettle method. Standards for frozen foods are improving and will continue to improve. (5) There is need for more research on quality maintenance storage life at zero degrees Fahrenheit of different kinds of foods. (6) Importance of limiting use of above zero freezing compartments of refrigerators to temporary storage (2 weeks or less) needs greater emphasis. (7) Freezing information directed towards homemakers should give particular attention to the processing of fruits, vegetables, fish, and game, as these were products found to be usually processed at home. Homemakers should be cautioned that many foods bought on "special" are not packaged adequately for freezer storage. Many should be repackaged before freezing.

APPENDIX A

TABLES

Table 1. Foods now in home freezer longest period of time, recommended maximum storage period at 0° F., number foods in storage recommended time or less, number in storage more than recommended time and longest time in freezer reported.*

Foods in freezer longest time	Recommended time at 0°F.	In freezer recommended time or less	In freezer more than recommended time	Longest time in freezer reported
	Months	No.	No.	Years
Beef	12	16	2	2
Ground Beef	6	0	2	3
Pork	9	1	3	2
Pork Sausage	3	0	2	1.5
Chicken	10	3	0	.83
Turkey	8	1	1	1
Shellfish	4-6	1	0	.5
Game	6	0	2	1.5
Green beans	10	8	16	2
Corn	9	3	5	2
Squash	12	6	4	3.5
Field Peas	12	13	0	1
Butterbeans	12	15	2	2
English Peas	12	0	1	1.5
Okra	12	2	3	1.5
Cauliflower	12	1	0	1
Egg Plant	12	1	0	.75
Tomato Juice	12	0	1	3
Spinach	12	1	0	.92
Peaches	10	8	6	2
Strawberries	12	8	2	2
Blackberries	12	5	2	3
Other berries	12	1	1	2
Mixed fruit	12	1	1	1.5
Nuts	12	1	4	3
Butter	4-6	0	1	.75
Ice cream	5-6	0	1	.83
Cake	2-4	0	5	3
Bread	2-4	1	0	.08
Chili	2-4	0	1	.5
Soup Stock	2-4	0	1	1.5
Spanish Rice	2-4	0	1	1.33
Plum Pudding	2-4	0	1	2
Fish	6-9	0	2	2

*Two families had no foods in the freezer at the time of interview; 5 families did not specify kind of food, for example, named meat or vegetables, or said all food in eight months. Five families named two foods the same length of time. This is, therefore, a report from 165 families and on 170 foods.

Table 2. Longest period of time ever left foods in home freezer, recommended maximum storage period at 0°F., number foods in storage recommended time or less, number in storage more than recommended time and longest time ever in.*

Foods in freezer longest time ever	Recommended time at 0°F.	In freezer recommended time or less	In freezer more than recommended time	Longest time in freezer reported
	Months	No.	No.	Years
Beef	12	19	8	2
Ground Beef	6	0	4	3
Pork (not sausage)	9	1	6	2
Chicken	10	2	1	2
Turkey	8	1	1	1
Fish	6-9	0	4	4
Game	6	0	6	3
Green beans	10	6	14	3
Corn	9	2	8	2
Squash	12	3	5	3
Field Peas	12	8	8	3
Butterbeans	12	2	2	2
English Peas	12	0	1	1.67
Okra	12	1	4	4
Cauliflower	12	1	0	1
Tomato Juice	12	0	1	6
Pumpkin	12	0	1	2
Peaches	10	3	5	3
Strawberries	12	5	10	3
Blackberries	12	2	2	4
Mixed fruit	12	0	1	1.5
Figs	10	0	1	2
Nuts	12	1	6	3
Butter	4-6	0	1	.75
Cakes	2-4	0	6	3
Bread	2-4	0	1	.75
Cheese (cheddar)	4-6	0	1	2
Vegetable Soup	2-4	0	1	2
Spaghetti Sauce	2-4	0	1	1.5

*Five families gave indefinite information, named meat, fruit, or vegetables or said all food in nine months. Table 2 includes data from 167 families.

Table 3. Foods now in locker longest period of time, recommended maximum storage period at 0°F., number foods in storage recommended time or less, number in storage more than recommended time and longest time in locker reported.*

Foods in locker longest time	Recommended time at 0°F.	In locker recommended time or less	In locker more than recommended time	Longest time in locker reported
	Months	No.	No.	Years
Beef	12	32	2	1.5
Ground Beef	6	1	1	1
Lamb	12	1	0	1
Pork (not sausage)	9	1	1	2
Chicken	10	2	1	1.00
Squirrel	6	0	1	.58
String beans	10	0	3	1.5
Corn	9	1	1	.83
Okra	12	0	1	2
Butterbeans	12	0	1	2
Field Peas	12	4	0	1
Peaches	10	1	0	.75
Blackberries	12	2	0	1
Pecans	12	0	1	3
Chili	2-4	0	1	1

*This includes information from 59 families. Seven families were not renting lockers at the time of the interview but had rented one during the year. One family who was renting a locker had no food stored. Three families gave indefinite information such as meat.

Table 4. Longest period of time ever left foods in locker, recommended maximum storage period at 0°F., number foods in storage recommended time or less, number in storage more than recommended time and longest time ever in.*

Food in locker longest time ever	Recommended time at 0°F.	In locker recommended time or less	In locker more than recommended time	Longest time in locker reported
	Months	No.	No.	Years
Beef	12	24	4	2
Ground Beef	6	0	3	3.5
Lamb	12	1	0	1
Liver	6	0	1	1
Pork (not sausage)	9	1	2	1
Fish	6-9	0	1	1
Chicken	10	1	4	2
Wild Duck	6	1	0	.33
String beans	10	0	6	2
Corn	9	1	0	.5
Field Peas	12	3	1	1.33
Okra	12	1	2	2
Butterbeans	12	1	2	2
Peaches	10	0	1	5
Strawberries	12	1	3	3
Apple Sauce	12	0	1	2
Pecans	12	0	2	3

*No report from one family; 4 families gave indefinite information such as vegetables, meats; 3 families mentioned two foods each. Information is therefore on 68 foods from 65 families.

Table 5. Foods now in refrigerator freezing compartment longest period of time classified by whether frozen or unfrozen when put in and length of storage period. (Refrigerators having freezing compartments above zero degrees fahrenheit.)*

Foods in freezing compartments of refrigerators longest time	FROZEN WHEN PUT IN			NOT FROZEN WHEN PUT IN		
	In refrigerator 2 weeks or less	In refrigerator more than 2 weeks	Longest time in refrigerator	In refrigerator 2 weeks or less	In refrigerator more than 2 weeks	Longest time in refrigerator
	No.	No.	Months	No.	No.	Months
Beef	5	2	2.0	3	1	2
Lamb	1	0	.5	0	0	0
Pork (not sausage)	1	0	.25	0	1	1.5
Sausage	1	0	.25	0	0	—
Fish	2	2	10.0	1	0	.33
Shellfish	1	1	1.5	0	0	—
Chicken	2	0	.5	2	2	1.25
Squirrel	1	1	12.0	0	0	—
Wieners**	0	0	—	1	0	.5
Field Peas	0	1	1.0	0	0	—
Butterbeans	0	1	1 5	1	0	.50
Okra	0	1	1.0	0	0	—
Corn	1	0	.5	0	0	—
Peaches	1	0	.5	0	0	—
Fruit Juice	6	10	1.25	0	0	—
Cocoanut	0	0	—	0	1	2.0
Pecans	0	0	—	0	1	12.0
Cream Cheese	0	0	—	0	1	.75
Ice Cream	9	1	1.5	0	0	—
Bread	0	0	—	0	1	.75
Cake	0	0	—	1	1	.75

*Includes information from 69 families.
**Wieners not recommended for freezing.

Table 6. Foods now in refrigerator freezing compartment longest period of time classified by whether frozen or unfrozen when put in and length of storage period.* (Refrigerators having freezing compartments zero or below zero degrees fahrenheit.)**

Foods in freezing compartment of refrigerator longest time	FROZEN WHEN PUT IN			NOT FROZEN WHEN PUT IN		
	In refrigerator recommended time or less	In refrigerator more than recommended time	Longest time in refrigerator	In refrigerator recommended time or less	In refrigerator more than recommended time	Longest time in refrigerator
	No.	No.	Months	No.	No.	Months
Beef	1	0	.5	1	0	.5
Lamb	1	0	.5	0	0	—
Chicken	1	0	1.5	1	0	2
Field Peas	1	0	4	1	0	4
Butterbeans	2	0	6	0	0	—
Squash	1	0	2	0	0	—
Okra	1	0	2	0	0	—
Fruit Juice***	2	0	1.5	0	0	—
Pecans	0	0	—	1	0	12
Ice cream	1	0	.75	0	0	—
Cake	0	0	1.5	1	0	3
Bread	0	0	2	1	0	2

*See Tables 1 and 2 for recommended time for storage at zero degrees or under.
**Includes information from 16 families, but one family named two foods.
***Recommended storage time at zero degrees fahrenheit is 12 months.

Table 7. Longest period of time ever left foods in refrigerator classified by whether frozen or unfrozen when put in and length of storage period. (Refrigerators having freezing compartments above zero degrees fahrenheit.)*

Foods in freezing compartment of refrigerator longest time	FROZEN WHEN PUT IN			NOT FROZEN WHEN PUT IN		
	In refrigerator 2 weeks or less	In refrigerator more than 2 weeks	Longest time in refrigerator	In refrigerator 2 weeks or less	In refrigerator more than 2 weeks	Longest time in refrigerator
	No.	No.	Months	No.	No.	Months
Beef	8	6	5	5	0	.5
Lamb	0	0	—	1	0	.33
Pork (not sausage)	0	1	1.5	0	2	2
Sausage	0	2	3	1	0	.25
Fish	1	2	10	0	1	2.0
Chicken	1	1	2 0	1	1	1.5
Game	1	2	4.0	0	0	—
Green Beans	0	0	—	0	0	1.5
Butterbeans	1	1	2.0	0	0	—
Field peas	0	0	—	0	1	.75
Okra	0	0	—	0	1	1.0
Squash	0	0	—	0	1	1.5
Peaches	1	2	3.0	0	0	—
Strawberries	0	2	12	0	0	—
Juices	2	2	2.0	0	0	—
Pecans	0	0	—	0	2	12.0
Cocoanut	0	0	—	0	1	2.5
Ice Cream	5	1	1.5	0	0	—
Cakes	0	0	—	0	1	2.0
Bread	0	0	—	0	1	1.5
Meat Pies	1	2	1.5	0	0	—
Fruit Pies	0	2	2	0	0	—

*Includes information from 68 families. One family did not report.

Table 8. Longest period of time ever left foods in refrigerator, classified by whether frozen or unfrozen when put in and length of storage period.* (Refrigerators having freezing compartments zero or below zero degrees fahrenheit.)**

Foods in freezing compartment of refrigerator longest time	FROZEN WHEN PUT IN			NOT FROZEN WHEN PUT IN		
	In refrigerator recommended time or less	In refrigerator more than recommended time	Longest time in refrigerator	In refrigerator recommended time or less	In refrigerator more than recommended time	Longest time in refrigerator
	No.	No.	Months	No.	No.	Months
Beef	4	0	6	0	0	—
Lamb	1	0	6	0	0	—
Pork (not sausage)	1	0	1.5	0	0	—
Chicken	0	0	—	2	0	2
Green beans	1	0	1.5	0	0	—
Peaches	1	0	3	0	0	—
Fruit juices***	3	0	6	0	0	—
Pecans	0	0	—	1	0	12
Ice Cream	1	0	1.5	0	0	—
Bread	0	0	—	1	0	1
Broth***	0	0	—	0	1	6

*See Tables 1 and 2 for recommended time for storage at zero degrees or under.

**Two families reported two foods and one reported no food.

***Recommended storage time at zero degrees fahrenheit is 12 months for fruit juices and 2 to 4 months for broth.

Table 9. Percentage of families storing and average amount per family storing specified frozen foods in lockers and home freezers during 1956-57 classified by family income.

Foods	Under $4000		$4000-5,999		$6000-9,999		$10,000 & over	
	% Storing	Av. amt. by family storing	% Storing	Av. amt. by family storing	% Storing	Av. amt. by family storing	% Storing	Av. amt. by family storing
Beef and veal, lbs.	88	239	98	280	92	341	89	412
Pork, lbs.	46	144	44	80	30	98	39	135
Lamb & mutton, lbs.	0	0	6	42	7	48	12	77
Lunch meats, lbs.	0	0	4	31	1	6	7	64
Fryers, hens, lbs.	74	142	76	127	72	138	77	177
Other poultry, lbs.	11	38	18	25	21	50	38	80
Fish, lbs.	46	28	36	21	42	43	59	54
Shellfish, lbs.	17	30	18	14	30	15	30	36
Game, lbs.	37	22	24	25	21	37	25	42
Butter, lbs.	26	11	8	9	9	21	9	70
Oleo, lbs.	8	19	8	27	0	0	4	104
Whipped cream and milk, pts.	0	0	0	0	0	0	5	11
Cheese, lbs.	0	0	0	0	1	24	2	50
Commercially-frozen ice cream, gals.	17	15	14	19	25	16	38	42
Eggs (doz.)	0	0	0	0	4	9	2	5
Fresh fruits and Juices, pts.	74	72	70	90	64	93	55	88
Commercially-frozen fruits, lbs.	3	8	12	16	7	21	20	16
Commercially-frozen juices, 6 fl. oz. can	16	73	12	95	9	105	34	187
Fresh vegetables, pts.	88	230	84	181	81	192	78	160
Commercially-frozen vegetables, lbs.	6	23	8	84	3	14	21	171
Nuts, lbs.	54	11	42	12	52	17	57	21
Home-prepared foods, lbs.	11	12	20	44	19	13	18	102
Ready-prepared foods, lbs.	11	137	14	132	19	77	41	234

Table 10. Percentage of families storing and average amount per family storing specified frozen foods in lockers and home freezers during 1956-57, classified by total cubic feet of freezing space they have.

Foods	Under 10 cu. ft.		10.1-15.0 cu. ft.		15.1-20.0 cu. ft.		20.1 & over cu. ft.	
	% Storing	Av. amt. by family storing	% Storing	Av. amt. by family storing	% Storing	Av. amt. by family storing	% Storing	Av. amt. by family storing
Beef & veal, lbs.	85	204	92	338	92	342	100	393
Pork, lbs.	28	73	35	107	35	97	58	150
Lamb & Mutton, lbs.	5	45	6	103	3	58	15	39
Lunch meat, lbs.	0	0	8	42	2	38	2	75
Fryers, hens, lbs.	52	138	77	159	81	146	83	136
Other poultry, lbs.	15	33	23	55	18	41	39	80
Fish, lbs.	20	21	52	31	50	46	54	54
Shellfish, lbs.	15	14	26	20	26	25	32	29
Game, lbs.	15	28	25	19	31	33	29	49
Butter, lbs.	2	30	14	13	13	19	15	53
Oleo, lbs.	2	20	6	72	2	48	7	6
Whipped cream, milk, pts.	0	0	2	24	0	0	5	5
Cheese, lbs.	0	0	0	0	2	24	2	50
Commercially-frozen ice cream, gals.	8	9	25	26	27	28	36	30
Eggs, doz.	0	0	3	7	2	15	2	5
Fresh fruits and juices, pts.	42	52	65	74	69	80	80	131
Commercially-frozen fruits, lbs.	2	8	15	16	11	13	12	25
Commercially-frozen fruit juices, 6 fl. oz. can	8	53	18	143	16	111	29	184
Fresh vegetables, pts.	55	119	83	166	94	180	90	273
Commercially-frozen vegetables, lbs.	2	56	9	222	11	74	15	94
Nuts, lbs.	22	15	55	13	60	15	61	24
Home-prepared foods, lbs.	5	8	23	35	16	74	24	40
Ready-prepared foods, lbs.	2	482	22	183	31	82	32	251

Table 11. Percentage of families storing specified types of frozen foods in lockers and home freezers, 1956-57, and average amount stored by those storing, classified by source of food.*

Foods	BOUGHT		HOME-PRODUCED**		GIFT	
	% Storing	Av. amt. bought per family buying	% Storing	Av. amt. home-produced per family home-producing	% Storing	Av. amt. given per family receiving
Beef & veal, lbs.	84	311	11	342	2	251
Pork, lbs.	25	76	8	258	8	55
Lamb & mutton, lbs.	5	67	1	10	1	53
Lunch meats, lbs.	3	53	0	0	1	6
Fryers, hens, lbs.	67	143	12	107	3	29
Other poultry, lbs.	15	58	8	46	4	27
Fish, lbs.	9	27	29	48	10	20
Shellfish, lbs.	23	24	1	15	1	13
Game, lbs.	0	0	24	32	4	11
Butter, lbs.	5	34	4	25	3	11
Oleo, lbs.	4	41	0	0	0	0
Whipped cream, milk, pts.	1	11	0	0	0	0
Cheese, lbs.	1	37	0	0	0	0
Commercially-frozen ice cream, gals.	25	27	0	0	0	0
Eggs, doz.	1	10	1	8	1	5
Fresh fruits and juices, pts.	54	62	26	73	15	32
Commercially-frozen fruits, lbs.	11	17	0	0	0	0
Commercially-frozen fruit juices, 6 fl. oz. can	18	140	0	0	0	0
Fresh vegetables, pts.	42	102	46	191	23	99
Commercially-frozen vegetables, lbs.	10	123	0	0	0	0
Nuts, lbs.	15	9	19	19	24	14
Home-prepared foods, lbs.***	17	45	1	60	1	46
Ready-prepared foods, lbs.	23	167	0	0	1	11

*Some families had the same food from more than one source.

**Home-produced food included food obtained from woods, streams, and fields by family members.

***Mixtures, were classified by source of principal ingredient.

Table 12. Percentage of families storing specified fruits, vegetables, and ready-prepared foods in home freezers and lockers during 1956-57, total amounts of these foods bought and average expenditures per families buying.

Foods	Percent of families storing	Total amount bought	Total cost	Average cost per family buying
			Dollars	Dollars
FRESH FRUITS	54	6846.5 pts.	809.05	7.22
Peaches	36	3513 pts.	362.24	4.77
Strawberries	22	1870.5 pts.	300.55	6.68
Blackberries	14	818 pts.	81.66	2.82
Apples	5	401 pts.	37.00	3.36
Dewberries	3	142 pts.	15.10	2.16
All other	1	102 pts.	12.50	4.17
COMMERCIALLY-FROZEN FRUITS	11	365.58 lbs.	131.36	5.71
Strawberries	10	296.2 lbs.	99.14	4.96
Peaches	2	31.88 lbs.	14.66	3.67
Rhubarb	*	7.5 lbs.	4.20	1.00
		Number (6 oz. cans)		
COMMERCIALLY-FROZEN FRUIT JUICES	18	5824	817.55	22.10
Orange	14	3534	555.79	19.17
Fruit juices (unspecified)	3	1446	236.30	33.76
Lemonade	1	330	12.23	4.08
Grape	1	432	10.32	3.44
Other	1	82	2.91	1.46
FRESH VEGETABLES	42	8837.5 pts.	693.15	7.88
Field peas	29	2596.5 pts.	207.25	3.45
Butterbeans	28	2455 pts.	245.50	4.23
String beans	12	1426 pts.	73.40	2.82
Okra	11	404 pts.	22.22	1.01
Corn on Cob**	10	620 pts.	38.72	1.84
Creamed Corn	8	662 pts.	38.40	2.40
Squash	4	162 pts.	11.95	1.33
Cut Corn	3	144 pts.	10.40	1.73
Lady peas	1	60 pts.	6.00	2.00
English peas	1	52 pts.	9.01	3.00
Turnip Greens	1	37 pts.	3.00	1.00
All others	3	219 pts.	27.30	3.90
COMMERCIALLY-FROZEN VEGETABLES	10	2394.25 lbs.	849.31	42.47
Broccoli	7	234.40 lbs.	135.16	9.65
Spinach	5	375.65 lbs.	110.88	11.09
Okra	4	190.20 lbs.	49.92	5.55
Brussels Sprouts	4	113.70 lbs.	45.65	5.07
Butterbeans	4	300.90 lbs.	103.64	12.96
Cauliflower	4	148.05 lbs.	46.25	5.78
English Peas	4	127.55 lbs.	42.62	5.33
String Beans	3	122.00 lbs.	49.72	8.29
Succotash	2	173.75 lbs.	73.65	14.73
Turnip Greens	2	113.80 lbs.	32.40	6.48
Mustard Greens	2	87.55 lbs.	25.11	5.02
Cut Corn	2	60.00 lbs.	12.90	2.58
Corn on Cob	2	155.10 lbs.	57.82	14.46
Asparagus	2	21.30 lbs.	10.98	2.75
Mixed vegetables	2	17.50 lbs.	4.20	1.05
Field Peas	1	71.20 lbs.	20.62	10.31
Squash	1	20.00 lbs.	5.90	2.95
All Other	1	61.60 lbs.	21.89	7.30
HOME-PREPARED FOODS	17	1698.35 lbs.	550.56	15.73
Cake (not fruit)	9	367.75 lbs.	172.04	9.06
Spaghetti Sauce	3	272.00 lbs.	82.61	11.80
Fruit Cake	3	62.0 lbs.	32.40	4.63
Fruit Pies	2	130.25 lbs.	34.80	6.96
Ice cream	2	161.00 lbs.	74.34	18.59
Rolls	1	440.0 lbs.	83.64	27.88
Cookies & cup cakes	1	38.75 lbs.	12.70	4.23
Frozen fruit salad	1	18.50 lbs.	6.84	3.42
All other	3	198.10 lbs.	51.19	7.31
READY-PREPARED FOODS***	23	7411.00 lbs.	1972.55	41.97
Bread	16	4669.00 lbs.	859.60	26.05
Rolls	7	618.75 lbs.	259.18	17.28
Buns	5	531.50 lbs.	161.40	16.14
Meat & poultry pies	5	397.00 lbs.	185.45	18.54
Fruit pies	5	233.25 lbs.	81.48	8.15
Cakes	4	484.00 lbs.	190.47	23.81
Biscuit	1	66.00 lbs.	19.50	6.50
Sweet Rolls	1	62.50 lbs.	75.90	37.95
All other	4	349.00 lbs.	139.75	17.45

*Less than .5 percent.

**Two ears counted as a pint (2 would go in a pint plastic bag.)

***Does not include commercially-frozen ice cream since that is listed separately in Table 11.

Table 13 (a). Percent* of families storing food purchased from six sources.

Foods	Locker plants	Producers and peddlers	Retailers	Farmers markets	Processors and wholesalers	Food plans
Beef and veal	38	27	19	4	21	2
Pork	17	29	33	6	13	2
Lamb and mutton	54	18	27	9	0	0
Variety meats	0	0	67	0	33	0
Fryers and hens	9	24	54	0	21	1
Other poultry	0	39	52	0	6	3
Fish	5	26	53	0	5	10
Shellfish	0	15	85	0	0	2
Butter	0	50	30	10	10	0
Oleo	0	0	78	0	22	0
Whipped cream, milk	0	0	67	0	33	0
Cheese	0	0	50	0	50	0
Commercially-frozen ice cream	0	0	96	0	2	2
Eggs	0	0	100	0	0	0
Fresh fruits and juices	0	78	15	12	2	0
Commercially-frozen fruit	0	0	91	0	0	9
Commercially-frozen fruit juice	3	0	92	0	3	5
Fresh vegetables	0	69	4	30	0	0
Commercially-frozen vegetables	0	0	85	0	5	10
Nuts	0	32	58	0	3	0
Home-prepared foods	3	0	97	3	0	0
Ready-prepared foods	0	2	96	0	2	2

*The percent storing from various sources adds up to more than 100 since some families bought food to store from more than one source.

Table 13 (b). Source of the food purchased*, total amount bought and average cost per family buying.**

Foods	Locker Plants		Producers and Peddlers		Retailers		Farmers Market		Processors and Wholesalers		Food Plans	
	Total amount bought	Av. cost per family buying	Total amount bought	Av. cost per family buying	Total amount bought	Av. cost per family buying	Total amount bought	Av. cost per family buying	Total amount bought	Av. cost per family buying	Total amount bought	Av. cost per family buying
		Dollars		Dollars		Dollars		Dollars		Dollars		Dollars
Beef and veal, lbs.	17201	129.07	12913	100.53	7580	117.82	4053	252.25	11666	148.34	687	111.56
Pork, lbs.	732	44.89	1390	30.93	1147	30.54	240	22.87	226	14.58	10	3.50
Lamb & mutton, lbs.	515	52.50	100	16.00	56	13.41	65	23.50	0	0	0	0
Variety meats, lbs.	0	0	0	0	143	17.88	0	0	176	30.66	0	0
Fryers & hens, lbs.	1422	37.60	3041	32.64	9628	41.74	0	0	5807	64.56	120	22.80
Other poultry, lbs.	0	0	1042	41.09	606	20.92	0	0	136	35.94	24	14.19
Fish, lbs.	15	9.00	135	13.00	263	14.34	0	0	10	4.80	32	8.80
Shellfish, lbs.	0	0	176	13.13	963	13.57	0	0	0	0	15	11.64
Butter, lbs.	0	0	35	3.80	273	60.03	4	2.00	24	5.52	0	0
Oleo, lbs.	0	0	0	0	345	9.62	0	0	26	2.13	0	0
Whipped cream, milk, pts.	0	0	0	0	28	2.84	0	0	6	4.20	0	0
Cheese, lbs.	0	0	0	0	50	35.00	0	0	24	7.20	0	0
Commercially-frozen ice cream, gals.	0	0	0	0	1344	38.60	0	0	24	16.80	3	4.20
Eggs, doz.	0	0	0	0	20	2.88	0	0	0	0	0	0
Fresh fruits and juices, pts.	0	0	5436	6.96	682	6.24	631	6.00	36	4.50	0	0
Commercially-frozen fruits, lbs.	0	0	0	0	337	5.73	0	0	0	0	44	5.48
Commercially-frozen fruit juices (6 oz. can)	48	6.00	0	0	4771	21.96	0	0	113	17.00	264	17.75
Fresh vegetables, pts.	0	0	5882	7.02	40	.82	3051	10.38	0	0	0	0
Commercially-frozen vegetables, lbs.	0	0	0	0	2221	47.76	0	0	38	12.50	202	26.34
Nuts, lbs.	0	0	101	4.32	141	5.04	0	0	15	3.00	0	0
Home-prepared foods, lbs.	48	5.76	0	0	1515	15.89	9	2.40	0	0	0	0
Ready-prepared foods, lbs.	0	0	4	6:00	7692	43.56	0	0	130	10.40	15	6.00

*There were 11 food items homemakers could not remember from which source they purchased.

**Cost refers to cost of the food plus all processing charges and other services.

Table 14. Homemakers who reported that buying specified foods to put in home freezers and/or lockers was a good idea and reasons given.

Foods	Total families buying No.	Percent of families buying who said good idea to buy	Percent of families giving specified reasons why buying was good idea*				
			Convenient, saves time and trouble	Saves money	Food is good, keeps well	Other reasons	Indefinite statements or no reply
Beef and veal	174	96	29	65	54	4	2
Pork	52	92	40	50	52	0	2
Lunch meats	6	67	4	50	50	0	0
Lamb and mutton	11	82	22	56	33	11	0
Fryers and hens	140	96	34	69	37	4	5
Other poultry	31	97	60	30	43	0	3
Fish and shellfish	50	96	54	50	35	6	2
Butter, oleo, cream, milk, eggs, cheese	16	100	38	50	25	6	6
Commercially-frozen ice cream	51	96	73	57	29	8	2
Fresh fruits and juices	112	93	30	32	76	6	2
Commercially-frozen fruits	23	91	38	38	29	14	5
Commercially-frozen juice	37	95	51	43	14	17	6
Fresh vegetables	88	90	24	44	58	9	9
Commercially-frozen vegetables	20	95	21	32	32	11	21
Nuts	31	90	56	52	56	0	7
Ready-prepared foods	47	94	89	39	18	0	5

*Some homemakers gave more than one reason.

Table 15. Homemakers who reported that buying specified foods to put in home freezers and/or lockers was not a good idea and reasons given.*

Foods	Total families buying	Percent of families buying who said not good idea to buy	Percent of families giving specified reasons why buying was not a good idea			
			Not economical	Food not good, got rancid, etc.	Family doesn't use much, bought too much	Too much trouble or time to prepare
Beef and veal	174	4	71	57	14	14
Pork	52	8	50	50	0	0
Lunch meats	6	33	0	0	100	0
Lamb and mutton	11	18	50	50	0	0
Fryers and hens	140	4	50	50	33	0
Other poultry	31	3	100	0	0	0
Fish and shellfish	50	4	50	50	0	0
Commercially-frozen ice cream	51	4	50	0	50	0
Fresh fruit & juices	112	7	50	100	25	0
Commercially-frozen fruits	23	9	50	50	0	0
Commercially-frozen juices	37	5	50	50	0	0
Fresh vegetables	88	10	22	78	0	11
Commercially-frozen vegetables	20	5	0	100	100	0
Nuts	31	10	0	50	75	0
Ready-prepared food	47	6	100	0	0	0

*Some families gave more than one reason why buying was not a good idea.

Table 16. Who got specified foods ready for freezing.

Foods*	Number families storing	Frozen** as bought or received very little preparation	*** Family prepares	**** Locker plant prepares	***** Other
		Percent	Percent	Percent	Percent
Beef and veal	192	39	2	63	5
Pork	80	32	19	46	6
Lamb and mutton	15	33	13	60	0
Luncheon meats	7	100	0	0	0
Fryers, hens	155	70	24	7	2
Other poultry	48	62	44	19	10
Fish	95	23	79	2	0
Shellfish	52	79	27	0	0
Game	53	8	92	2	4
Oleo	9	100	0	0	0
Butter, cream, milk, cheese and eggs	33	64	76	0	0
Commercially-frozen fruit juices	51	100	0	0	0
Fresh fruits and juices	135	5	99	0	0
Commercially-frozen fruits	23	100	0	0	0
Commercially-frozen fruit juices	37	100	0	0	0
Fresh vegetables	171	6	99	1	0
Commercially-frozen vegetables	20	100	0	0	0
Nuts	107	12	79	0	0
Home-prepared foods	37	3	100	0	0
Ready-prepared foods	47	100	0	0	0

*Total is more than 100 percent since in some cases more than one way was used to get a food ready for processing.

**Includes food put in freezer as bought or as received as a gift with no or little effort on the part of the family. Includes meat bought from locker plant already processed and packaged, as well as products on which family members performed no service except wrapping.

***All or a very large part of processing and preparing done by family members and/or household employees, relatives, close friends.

****Services performed by locker plant - arranged and paid for by family members.

*****Services performed by other processors or persons - arranged and paid for by family members, services performed by both locker and family or by other processors and family.

Table 17. Percentage of families storing bought, home-produced, and gifts of foods and having expenses for processing and other service charges, and average expenses per family having such expense.

Foods	Bought Food			Home-Produced Food			Gifts of Food		
	Number families storing	% with expense for processing & other charges	Average expense per family having	Number families storing	% with expense for processing & other charges	Average expense per family having	Number families storing	% with expense for processing & other charges	Average expense per family having
Beef and veal	174	65	15.28	22	95	22.03	5	100	14.47
Pork	52	25	7.51	16	88	20.45	17	41	4.58
Lamb & mutton	11	36	5.50	2	0	0	3	67	4.94
Fryers & hens	140	12	1.03	24	25	4.35	6	17	1.00
Other poultry	31	13	2.21	16	0	0	8	25	2.60
Fish	50	0	—	61	7	4.36	20	0	—
Game	0	0	—	49	12	2.43	8	25	2.71
Fresh vegetables	88	1	7.16	96	1	3.00	48	0	—
Home-prepared foods	35	0	—	1	100	1.79	1	0	—

Table 18. Percentage of families storing* food in lockers and/or home freezers, classified by kind of packaging material used.

Foods	Plastic bag and box	Plastic bag only	Commercial package box wax paper	Freeze paper and tape	Aluminum foil	Glass jar	Milk carton	Commercial butter or oleo carton	Ice cream carton	Cardboard tray covered with cellophane	Cellophane	Plastic containers	Wax coated freezer box	Cardboard box not spec. as waxed	Wax paper	** Other
Beef and veal	3	2	2	99	2	0	0	0	0	1	0	0	0	0	0	0
Pork	9	6	0	79	4	0	0	0	0	0	6	0	0	0	0	6
Lamb and mutton	0	13	0	93	0	0	0	0	0	0	0	0	0	0	0	0
Lunch meat	0	28	0	0	0	0	0	0	0	0	72	0	0	0	0	0
Fryers and hens	0	44	2	49	2	0	0	0	0	9	1	0	0	0	1	2
Other poultry	0	38	0	46	8	0	0	0	0	4	4	0	0	0	0	0
Fish	19	12	11	47	16	0	4	0	0	0	0	0	0	0	0	1
Shellfish	13	6	67	6	4	8	4	0	0	0	0	4	0	2	0	2
Game	26	17	0	55	13	0	2	0	0	0	0	2	0	2	0	0
Butter, cream, milk, cheese, and eggs	15	24	0	9	21	3	3	39	0	0	3	3	0	0	9	3
Commercially-frozen ice cream	0	0	0	0	0	0	0	0	100	0	0	0	0	0	0	0
Fresh fruits	32	54	2	1	1	6	8	0	0	0	0	15	12	4	0	0
Fresh vegetables	34	67	4	3	1	2	4	0	0	0	0	5	5	1	0	0
Nuts	5	75	0	0	0	6	3	0	0	0	2	6	0	1	0	4
Home-prepared foods	3	32	0	5	51	8	0	0	0	0	0	11	0	0	0	11
Ready-prepared foods	0	11	32	0	4	2	0	0	0	0	11	2	0	4	74	0

*Percentages add up to more than 100 since some foods were stored in more than one type of package.
**Includes 5 food items with no report on packaging.

Table 19. Percentage of families buying packaging material of specified kinds during the past year and average amount paid for each type of material per family buying.

Packaging Material	Percent of families buying	Average expenditure by families buying
		Dollars
Plastic bags	71	3.34
Freeze boxes	11	3.04
Plastic containers	9	11.29
Wax paper containers	3	1.92
Freeze paper	30	3.22
Aluminum foil	24	4.94
Freeze tape	17	1.15
Other (other wraps, ascorbic acid)	12	.99

Table 20. Source of food before being placed in the 181 home freezers, quantities in which placed in freezer, and whether frozen or not when put in freezer.

Foods	Source before placed in freezer and quantities in which placed in freezer											
	Grocery Store		Other places of purchase		Family Table		Rented Locker		Family farm, yard; woods; streams		Gifts	
	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks
	Number											
Meats	30	50	18	229	15	1	6	43	0	33	2	14
Poultry	11	54	2	54	13	3	0	1	0	8	1	6
Fish or shellfish	21	17	2	15	1	0	0	0	10	44	2	10
Game	0	0	0	0	0	0	0	1	5	40	3	7
Ice cream or frozen dessert	43	26	1	3	3	0	0	0	0	0	0	0
Butter, oleo*	7	6	0	5	2	0	0	0	0	4	0	2
Milk, cream	7	0	0	0	3	0	0	0	0	0	0	0
Cheese	1	1	0	0	2	0	0	0	0	0	0	0
Eggs	0	0	0	1	0	0	0	0	0	0	0	0
Fruit juice	35	21	0	4	0	0	0	0	0	3	0	1
Fruit	25	29	5	107	0	1	0	0	1	43	5	22
Vegetables	60	56	3	112	9	2	0	1	7	302	7	91
Prepared dishes**	117	57	3	11	76	29	0	0	0	0	4	5
Nuts	3	10	1	13	1	0	0	0	1	33	2	33
Miscellaneous***	3	2	0	1	7	0	0	0	0	0	0	1

Foods	Source before placed in freezer and whether frozen when put in freezer											
	Grocery Store		Other places of purchase		Family Table		Rented Locker		Family farm, yard; woods; streams		Gifts	
	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen
	Number											
Meats	18	62	196	51	0	16	45	4	25	8	12	4
Poultry	7	58	19	37	0	16	1	0	2	6	2	5
Fish or shellfish	34	4	9	8	0	1	0	0	2	52	4	8
Game	0	0	0	0	0	0	1	0	5	40	5	5
Ice cream or frozen desserts	66	3	3	1	3	0	0	0	0	0	0	0
Butter, oleo	0	13	0	5	0	2	0	0	0	4	0	2
Milk, cream	0	7	0	0	0	3	0	0	0	0	0	0
Cheese	0	2	0	0	0	2	0	0	0	0	0	0
Eggs	0	0	0	1	0	0	0	0	0	0	0	0
Fruit juice	50	6	1	3	0	0	0	0	1	2	0	1
Fruit	40	14	4	108	0	1	0	0	3	41	3	24
Vegetables	90	26	12	103	0	11	1	0	6	303	9	89
Prepared dishes	62	112	3	11	0	105	0	0	0	0	4	5
Nuts	1	12	0	14	0	1	0	0	0	34	0	35
Miscellaneous	0	5	0	1	0	7	0	0	0	0	0	1

*Includes 1 chicken fat.

**Pies (meat, poultry, fruit), bread, chili, cake, soup mixtures, etc.

***Cornmeal, candied fruit, candy, etc.

NOTE: Some families named more than one kind of poultry, more than one kind of meat, etc.

Table 21. Source of food before being placed in freezing compartments of the 98 refrigerators, quantities in which placed in refrigerator, and whether frozen or not when put in refrigerator.

Foods	Source before placed in refrigerator and quantities in which placed in refrigerator											
	Grocery Store		Other places of purchase		Family Table		Home freezer or rented locker		Family farm, yard, woods and streams		Gifts	
	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks	2 weeks or less	More than 2 weeks
	Number											
Meats	20	11	5	3	3	0	29	9	0	0	0	0
Poultry	14	2	0	0	3	0	2	1	0	0	0	0
Fish or shellfish	5	2	2	0	1	0	0	0	1	0	2	0
Game	0	0	0	0	0	0	1	0	2	1	2	1
Ice cream or frozen desserts	40	9	2	0	3	0	0	0	0	0	0	0
Butter, oleo	0	1	3	0	2	0	0	0	0	0	0	0
Fruit juice	25	9	2	0	1	1	0	0	0	0	0	0
Fruit	5	0	0	0	0	0	2	3	1	0	2	0
Vegetables	25	3	6	2	2	2	5	1	3	3	1	0
Prepared dishes*	18	1	3	0	9	0	0	1	0	0	0	0
Nuts	0	0	1	0	0	0	2	0	1	0	1	2
Miscellaneous**	3	0	0	0	4	0	0	0	0	0	0	0

Foods	Source before placed in refrigerator and whether frozen when put in refrigerator											
	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen	Frozen	Not Frozen
	Number											
Meats	14	17	6	2	0	3	38	0	0	0	0	0
Poultry	5	11	0	0	0	3	3	0	0	0	0	0
Fish & shellfish	6	1	1	1	0	1	0	0	0	1	0	2
Game	0	0	0	0	0	0	1	0	0	3	2	1
Ice cream or frozen dessert	49	0	2	0	1	2	0	0	0	0	0	0
Butter, oleo	0	1	0	3	0	2	0	0	0	0	0	0
Fruit juice	34	0	2	0	0	2	0	0	0	0	0	0
Fruit	5	0	0	0	0	0	5	0	0	1	2	0
Vegetables	27	1	8	0	0	4	6	0	0	6	1	0
Prepared dishes	6	13	0	3	0	9	1	0	0	0	0	0
Nuts	0	0	1	0	0	0	2	0	0	1	2	1
Miscellaneous	0	3	0	0	0	4	0	0	0	0	0	0

*Pies (meat, poultry and fruit), chili, cake, bread, etc.

**Cornmeal, candied fruit, jello, broth, cocoanut, milk, cream, cheese.

NOTE: Some families named more than one kind of poultry, more than one kind of meat, etc.

Table 22. Percentage of families who would be interested in buying specified foods to store for freezing over next 12 months, average amount named by those naming* an amount and highest and lowest amounts named.

Food	Percent interested in buying	Average amount named by those naming	Highest amount named by those naming	Lowest amount named by those naming
Beef, lbs.	81	280	1170	42
Pork, lbs.	17	153	1000	15
Lamb, lbs.	9	74	300	10
Fryers, No.	73	70	800	6
Hens, No.	26	13	50	4
Field peas, qts.**	36	65	128	12
Butterbeans, qts.	35	58	192	6
String beans, qts.	21	45	128	6
Corn, qts.	16	32	96	6
Okra, qts.	5	23	32	5
Squash, qts.	2	30	64	6
All other vegetables, qts.***	8	16	27	5
Peaches, qts.	48	58	128	8
Strawberries, qts.	31	32	72	8
Blackberries, dewberries, qts.	11	16	30	4
Apples, qts.	10	49	96	32
All other fruits****, qts.	4	13	24	4

*Some homemakers who said they were interested in buying did not name an amount.
**Includes lady peas and crowder peas.
***Includes turnip greens, broccoli, English peas, asparagus, brussels sprouts, spinach.
****Includes figs, plums, fruit juices.

Table 23. From whom interviewees, interested in buying a steady supply of specified foods during the next 12 months, would prefer to buy.*

From whom prefer to buy	Beef	Pork	Lamb	Fryers	Hens	Vegetables	Fruits
				Percent			
Locker plant	40	34	42	14	4	0	0
Farmer**	28	46	16	16	39	65	66
Grocery store or retailer	13	11	26	50	50	6	9
Packing house or other wholesaler	15	6	5	14	0	0	1
Stockyards	1	0	0	0	0	0	0
Farmers Markets	0	0	0	0	2	17	11
Trucker or peddler	0	0	0	0	0	0	10
Food plan	1	0	0	1	2	2	2
Unspecified***	2	3	11	5	4	12	5
Number families interested in steady supply	169	35	19	152	54	102	133

*A few named more than one source for a type of food. This is especially the case with fruit where several said they wanted to buy strawberries already frozen, but to buy peaches from a farmer.

**Includes 2 who mentioned 4-H club calves.

***Included general statements such as "where I can get best quality," and "where I can buy cheapest."

Table 24. Reasons given for wanting to buy food for freezing during the next 12 months. from specified sources.*

Reasons	Specified Sources			
	Locker Plant	Farmer	Grocery store or retailer	Packing house or other wholesaler
		Percent		
Can select own products	0	2	1	0
Good quality food, fresh food	54	94	31	41
Cheaper, can save money	30	62	58	39
Convenient, saves time	14	6	19	10
Prepared way we like it, already frozen, already dressed	27	*	11	4
Delivered to home	0	3	1	0
Previous experience good	6	1	1	0
Like to trade with local farmers	0	9	0	0
All other	4	*	1	6
No. wanting to buy specified foods from that source**	111	266	152	51

*Less than .05 percent.
**Adds up to more than 100 percent since some families gave more than one reason.

Table 25. Reasons given for not wanting to buy food for freezing in large quantities over
*Less than .05 percent.

Reasons	Beef	Pork	Lamb	Fryers	Hens	Vegetables	Fruits
				Percent			
Produce own or receive as gift	62	13	3	28	16	80	29
Prefer other types or forms of food; don't use so much of this frozen food	13	65	80	28	44	18	43
Quality previously bought poor, food doesn't keep well	2	1	0	2	0	0	0
Prefer to buy as needed in small amounts	18	11	7	36	20	8	13
Not economical, too much waste	13	2	2	5	1	3	5
Want space in freezer for something else; no room in freezer	2	5	3	5	9	4	15
Too much trouble to prepare; too long to thaw	2	1	1	4	2	8	9
No reason	0	3	8	0	12	2	15
Total number not interested in buying	39	173	189	52	154	106	75

*Some women gave more than one reason.

APPENDIX B

FOOD GROUPS

1. **Beef and Veal (lbs.)**
Whole beeves, halves, and quarters of beeves; beef steaks, roasts, stew meat, ground beef.

2. **Pork (lbs.)**
Whole hogs, halves and quarters of hogs, hams, bacon, sausage.

3. **Lamb and Mutton (lbs.)**
Whole lambs, legs of lamb, goat meat.

4. **Lunch meats (lbs.)**
Wieners, bologna, frankfurters and other lunch meat.

5. **Fryers, hens (lbs.)**
Fryers, hens, cornish hens.

6. **Other poultry (lbs.)**
Turkeys, ducks, and geese.

7. **Fish (lbs.)**
Such as perch, bream, catfish, and prepared fish sticks.

8. **Shellfish (lbs.)**
Oysters, crabs, shrimp, lobster.

9. **Game (lbs.)**
Rabbits, pheasants, quail, wild turkey, squirrel, deer.

10. **Butter (lbs.)**
(Purchased and home-produced)

11. **Oleo (lbs.)**

12. **Cream, Milk (pts.)**

13. **Cheese lbs.)**

14. **Commercially-frozen ice cream (gallons)**
This category includes one gallon of purchased sherbet stored by one family. Homemade ice cream is included with home-prepared foods.

15. **Eggs (doz.)**

16. **Fresh fruits, fresh fruit juices (pts.)**
Includes fresh fruits and juices put in freezer storage. These were: Peaches, apples, strawberries, pears, plums, figs, blackberries, boysenberries, dewberries, raspberries, huckleberries, himalaya berries, watermelon, cantaloupe, mixed fruits, blackberry juice, orange juice, watermelon juice, plum juice. There was a total of 192 pints of fresh fruit juice stored by 6 families.

17. **Commercially-frozen fruits (lbs.)**
Peaches, strawberries, rhubarb.

18. **Commercially-frozen fruit juices (6 fl. oz. cans)**
Orange juice, grape juice, lemonade, limeade.

19. **Fresh vegetables (pints)**
Includes fresh vegetables put in freezer storage. These were: Butterbeans, string beans, field peas (crowder peas, blackeye peas, lady peas)

English peas, corn on cob, cut corn, creamed corn, collards, turnip greens, spinach, mustard greens, okra, bell peppers, pumpkin, squash, egg plant, sweet potatoes, mixed vegetables, rutabagas, carrots, cabbage, sauerkraut, tomatoes, beets, parsnips. Includes 60 pints of fresh tomato juice stored by 2 families. Corn on the cob was frequently reported in number of ears rather than pints. However, as a number of homemakers stated that they put two ears in a pint size plastic bag, 2 ears were regarded as one pint.

20. **Commercially-frozen vegetables (lbs.)**

Butterbeans, string beans, crowder peas, English peas, corn on the cob, corn cut whole, creamed corn, collards, turnip greens, spinach, okra, mixed vegetables, cauliflower, asparagus, broccoli, Brussels Sprouts.

21. **Nuts (lbs.)**

Pecans (shelled and unshelled), shelled peanuts, English walnuts, prepared cocoanut.

22. **Home-prepared foods (lbs.)**

Food prepared ahead by homemaker including cakes, fruit pies, rolls, spaghetti sauce, shrimp gumbo, homemade ice cream, etc. For home-prepared foods the source was determined according to source of principal ingredient of dish.

23. **Ready-prepared foods (also some miscellaneous foods)**

Food prepared when bought or received as gift including bread, rolls, cakes, fruit pies, meat pies, etc., other foods such as cornmeal, candied fruit.

METHODS OF TRANSFORMING MEASURE OF FOODS TO WEIGHT, OF GETTING YIELDS IN FROZEN PRODUCTS FROM GROSS MEASURE OF PRODUCT.

The homemaker was allowed to report the food put in frozen storage either in weight or measure, whichever way she could report most accurately. Figures published by the Institute of Home Economics, Agricultural Research Service, U.S.D.A., were used for estimating weights from measures; also, for estimating yields. Also, assistance was obtained from Mrs. Gladys Boyette and Miss Edwina Morris of the Mississippi Agricultural Extension Service. Weight of unshelled pecans was determined by weighing. Weight of prepared mixtures was estimated from weights shown on canned foods of this type containing one pint.

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FARMERS MOVING OUT of Agriculture

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FARMERS MOVING OUT OF AGRICULTURE

By ANDREW W. BAIRD and WILFRID C. BAILEY[1]

The population of the United States has been characterized by a high degree of mobility between farm and non-farm occupations. In the past 35 years an average of more than two million persons have moved either to or from farms each year. In general the movement away from farms has been much greater than the movement to farms.

For the ten-year period between 1940 and 1950 a total of 8.6 million persons alive at both the beginning and end of the period migrated from farms. The net out-migration rate for the 1940 to 1950 period was 31 percent compared with 13 percent for 1930 to 1940. For the South, the region with the highest net farm out-migration, the rate was 36 percent. The farm out-migration rate for Mississippi was 35 percent, slightly below that for the South. The lowest rate, 21 percent, occurred in the northeastern United States.[2]

Information of a general nature is available on the mobility between farm and non-farm occupations. However, many questions may be raised concerning the individuals and land involved in this shift. What are the characteristics of the people who shift from farm to non-farm occupations? Is the shift a sudden one or are several steps or stages involved in the process? What happens to the land formerly operated by people who shift from farm to non-farm occupations?

It is the purpose of this article to examine some of these questions relative to data obtained in Alcorn County, Mississippi.

Loss of Farmers in Alcorn County

In 1955 schedules were taken from a sample of 161 farm operators[3] living in six communities in Alcorn County. Three years later schedules were again taken from the same group of farmers. It was found that over the three-year period 52 (32 percent) of those farming in 1954 were either no longer farming or were farming in different communities. Nine farms were taken over by new operators resulting in a net loss of 43 farm operators in the survey communities.

The changes were grouped into three types as follows:

	Number	Percent
Moved to farm in other community	8	15
Retired	15	29
Obtained non-farm employment	29	56
Total	52	100

There is an indication that communities located in the poorer farming areas and which are the greatest distance from sources of non-farm employment suffer the greater loss of farm operators. The two communities in the sample having the greater number of changes, Brush Creek and Mathis, are both located in poor farming areas and are long distances from sources of non-farm employment

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[1] This report is part of a larger study conducted by the Department of Rural Life of the Mississippi Agricultural Experiment Station and the Tennessee Valley Authority in cooperation with the Mississippi Agricultural Extension Service and the Alcorn County Community Development Council.

[2] Gladys Kleinwort Bowles. **Farm Population: Net Migration from the Rural-Farm Population.** (Washington, D. C.: U. S. Government Printing Office, 1956).

[3] Farmers included in this study had at least five acres of cropland, worked on the farm at least one-third of the time (approximately 100 days), lived on the farm in 1954, owned work power, and made their own decisions on enterprise. Schedules were taken in 1955 covering the 1954 crop year and the resurvey in 1958 covered the 1957 crop year.

(Table 1). Brush Creek had a 53 percent change and Mathis 47 percent. Lovejoy, with a 36 percent change, is a long distance from non-farm employment and a poor farming area. However, many changes in this community occurred prior to 1954. Farmington and McGlathery are both located in fairly good farming areas but are near non-farm employment. Hinkle, the community with the fewest changes, 18 percent, is a long distance from non-farm employment but has some of the best farming land in the county. In each community non-farm employment accounted for the greatest change.

The place of residence of those no longer farming was as follows:

	Moved		Remained	
	No.	%	No.	%
Retired	1	7	14	93
Non-farm employment	11	38	18	62
Total no longer farming	12	27	32	73

The population loss to the communities losing farmers is not as great as it might appear. Although they stopped farming, the majority, 73 percent, are still living in the same community as when they were farming. Of those no longer farming only one-fourth (27 percent) moved from the community in which they were living in 1954.

Those who stopped farming and had gone into non-farm employment gave the following reasons for doing so:

Reason for going into non-farm employment	Number	Percent
Make more money	19	66
No help on farm	4	14
Help pay for farm	2	7
Disabled	2	7
No land of own	1	3
Other	1	3
Total	29	100

An interesting point is that several individuals stated that their non-farm jobs were temporary. One said that as soon as his farm was paid for he planned to go back to farming altogether.

Characteristics of the People Who Shift from Farming to Non-farm Occupations

Part-time farming is often a transitional phase. For some it may serve as a means to becoming a full-time farmer in the future. In Alcorn County part-time farming is most often a step toward full-time non-farm employment. There is an indication that the transition from full-time farming to non-farm employment involves three steps: (1) The farmer obtains non-farm employment to supplement his farm income; (2) later the farm income tends to supplement the non-farm income, and (3) the final step is to stop farming altogether. The supporting data for these three steps are presented below in the characteristics of the people involved.

Seventy percent of the sample farm operators still farming in 1957 were full-time farmers in 1954 (Table 2). Thirty percent had non-farm employment to supplement their farm income. In contrast, 50 percent of those who quit farming were part-time farmers[4] in 1954. So a greater percentage of those who stopped farming had non-farm employment in 1954. But what about the 1957 occupation of those still farming? Sixty-five percent of those farming in 1957 were full-time farmers and 35 percent had non-farm employment. This suggests that more Alcorn County farmers are in the process of shifting to non-farm employment.

A comparison of income for those no longer farming and those still farming provides further evidence that part-time farming is a step toward full-time non-farm employment (Table 2). Eighty percent of the families no longer farming in 1957 had non-farm income in 1954. In con-

---

[4] For purposes of this article a farmer having any non-farm employment is considered a part-time farmer.

Table 1. Loss of farmers, 1954-1957.

Community	Total number of farmers, 1954	No longer farming in same community, 1957	
		Number	Percent
Brush Creek	19	10	53
Mathis	30	14	47
Lovejoy	11	4	36
Farmington	25	9	36
McGlathery	25	6	24
Hinkle	51	9	18
Total	161	52	32

trast, 63 percent of the families still farming in 1957 had non-farm income in 1954.

Those dropping out of farming also had a higher net family income and a higher family non-farm income. However, they had a lower gross farm income in 1954 This indicates that the man no longer farming first obtained a non-farm job to supplement his farm income. Later, as his non-farm income increased the farm income became supplementary to the non-farm income. The final step in the transition was to stop farming altogether.

A comparison of age shows that farmers are losing in numbers from both ends of the age limits (Table 2). The median age in 1957 of those working at non-farm employment was 41 and that of retired farmers was 70. The median age of those still farming was between the two, or 50 years. The median age of the entire group was 49 years.

It should be pointed out that between the two survey periods, 1954 and 1957, farmers became eligible for Social Security. This influenced both the age and number of farmers retiring. In the future it would be expected that a smaller number of farmers would retire during a three-year period. Also, they would be expected to retire at an earlier age.

Farmers who had gone into non-farm employment had the lowest number of years in school, the median number being seven (Table 2). Retired farmers and those still farming in 1957 had been to school a median of eight years.

Table 2. Comparison of those still farming with those who left farming.

	Still farming	Left farming
OCCUPATION		
1954 (percent)		
Full-time farmer	70	50
Part-time farmer	30	50
1957 (percent)		
Full-time farmer	65	—
Part-time farmer	35	—
INCOME (median dollars, 1954)		
Net family	541	679
Gross farm	1,351	1,009
Family non-farm	250	750
AGE (1957 median)		
Still farming	50	—
Non-farm employment	—	41
Retired	—	70
EDUCATION (1957 median)		
Still farming	8	—
Non-farm employment	—	7
Retired	—	8
FARM PRACTICE SCORE (1954 average)	6.2	5.1

A survey in 1954 on the knowledge and use of 12 recommended farm practices found that the average operator was using about half of the practices applicable to his farm.[5] Those not farming in 1957 were poorer operators in 1954 than were those who remained in farming (Table 2).

Operators who quit farming had had an average adoption score of 5.1 while those still farming had a score of 6.2.

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[5] Herbert A. Aurbach and Harold F. Kaufman. "Knowledge and Use of Recommended Farm Practices," **Mississippi Farm Research,** Vol. 19, No. 6 (June, 1956).

What Has Happened to the Land

In 1954 a total of 16,690 acres were operated by farmers included in the study (Table 3). Of this 5,605 acres was in crop. The men who left farming between 1954 and 1957 operated 5,009 acres of which 1,495 acres (29.8 percent) was in crop. The farmers remaining in production operated 11,681 acres in 1954 and had 4,110 acres (35.2 percent) in crop. In 1957 the same farmers operated 11,762 acres of which 4,076 acres (34.7 percent) was in crop. The question then is what happened to the pattern of land use?

The men who stopped farming between 1954 and 1957 had a smaller percentage of their land in crops in 1954 than those who stayed in farming. This along with their lower farm practices score and greater dependence on non-farm income and non-farm employment suggests the gradual reduction of the farming operation. With the large acreage going out of production, the remaining farms only added a total of 76 acres, or less than an acre per farm, and at the same time they reduced the total cropland by 34 acres.

Table 3. Farm land, 1954-1957.

	1954	1957
Still farming 1957		
Acres operated	11,681	11,762
Acres of crop	4,110	4,076
Percent in crop	35.2	34.7
Left farming after 1954		
Acres operated	5,009	—
Acres of crop	1,495	—
Percent in crop	29.8	—
Total		
Acres operated	16,690	—
Acres of crop	5,605	—
Percent in crop	33.6	—

Men on 52 farms cultivating 1,495 acres of cropland in 1954 were no longer farming in the survey communities in 1957. What happened to their land? (Table 4).

About 883 acres from 21 farms were farmed by someone else. Nine of the farms had new operators, four farms were consolidated with other farms, and 379 acres from portions of eight farms were rented out. Thirty-six farms (69 percent) had land that was either idle or in the Soil Bank. This represented 31 percent of the 1,495 acres of cropland. The usual pattern was to let the land go idle or put it in the Soil Bank, and in some cases rent out some of the better land for cotton or corn.

The data seem to suggest that some of those who stayed in farming let some of the poorer land go and replaced it with some of the better land formerly used by men who had quit farming. As a result the decrease in the number of farmers has not provided the remaining farmers

Table 4. Use in 1957 of cropland formerly operated by men no longer farming in the survey communities.

	Acres		Farms	
	Number	Percent	Number	Percent
Worked by someone else				
Whole farm	368	25	9	18
Consolidated with other farms	136	9	4	8
Portion of farm rented out	379	25	8	16
Total	883	59	21	42
Not farmed				
Idle	278	19	14	27
Soil Bank	183	12	22	42
Total	461	31	36	69
Use not known	151	10	4	8
All farms	1,495	100	*	*

*Adds up to more than 52 farms and 100 percent because some farms fall into more than one category.

with a larger land base. The land remaining in cultivation is probably the more productive. However, further reajustment is necessary before those who continue to farm achieve the optimum patten of land utilization.

In 1954 there was a total of 54,300 acres of cropland in Alcorn County. This was a decrease of 13,100 acres, or 3.9 percent per year, since 1949. In the six survey communities there has been a loss of 546 acres of cropland, or 3.2 percent per year. If this is representative, the loss for the whole county would be estimated at 5,290 acres. Similarly during the period between the 1949 and 1954 agricultural censuses there was a decrease of 20 percent in the number of farm operators,4 percent per year. Between the two survey periods, the net loss of farmers was 27 percent, or 9 percent per year. This would indicate that the loss in cropland was not as great during the last three years as during the previous five but that the loss of farm operators was higher.

Implications

The transition from farming to non-farm employment in Alcorn County has both economic and social implications. From the economic standpoint, part-time farming in this area appears to be a stage in the shift from farming to full-time non-farm employment. Not all the land formerly operated by men who went out of farming is being utilized by those remaining in farming. Although they are no longer farming they have retained much of their land. Some look upon their non-farm employment as temporary and expect to return to farming during periods of high farm prices or unemployment. This poses several problems for the various agricultural agencies.

Because of terrain and soil conditions much of the land in Alcorn County should not be in cultivation. To what extent has the occupational shift resulted in the poorer land going out of cultivation and has the better land been taken over by the remaining farmers? Is there need for a program directed at maintaining land withdrawn from production so that it can be put back into cultivation at some future time? What about use of idle land for grazing or timber development? Such programs would of necessity require a low labor and capital input.

At least three aspects of the occupational changes have social implications. The median age of the rural residents is rising because the younger men are turning to non-farm occupations and they are the ones who are most likely to leave the community. The rural communities are losing population as men move to other areas to find employment. Finally, many of those who retire or find non-farm employment continue to live on the same land but are classified as rural non-farm. Thus the occupational pattern of the rural community is shifting. These changes are having an impact on the structure of the community and on its role in the lives of its residents.

BULLETIN 569 NOVEMBER 1958

Comparative Costs of Cooling and Storing Milk in Cans and Bulk Tanks

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COMPARATIVE COSTS OF STORING MILK IN CANS AND BULK TANKS

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How the cost of cooling and storing milk on the farm in bulk tanks compares to that of using can coolers is of primary concern to dairy producers in Mississippi today. Since two types of bulk tanks, direct expansion and ice bank, are being used producers who are considering a change to the bulk system may also be interested in the comparative costs of the two.

Purpose

The purpose of this study was to provide some of the basic information needed to evaluate the feasibility of changing from the can system to the bulk system. Specifically, comparisons were made of butterfat tests, bacteria counts and cost items for each system over a wide range of production levels. Cost items compared include depreciation, interest on investment, repair, electricity, cleaning materials and labor.

Source of Data

This study is based on data obtained in 1957 from 41 members of the Noxubee Milk Producers Association who had converted from the can system to bulk tank systems during the previous year. Monthly reports on volume, butterfat tests and bacteria counts of milk delivered by each of these producers were obtained from records of the association. Each producer was interviewed to obtain information on labor requirement, cleaning materials used and changes in herd composition. Records on monthly consumption of electricity on each farm were provided by the Four-County Power Association, a utility cooperative serving the area. All this information was obtained for two periods — October 1955 - July 1956, when producers used the can system, and for corresponding months one year later, when all producers were using bulk tanks. Averages of installed prices for equipment in December 1957, as given by five equipment dealers in the state, were used to estimate costs for each system.

Comparisons of Non-Cost Items

Butterfat tests: The butterfat content of milk normally varies inversely with the level of production per cow. Thus, to compare butterfat tests for two periods, they must first be adjusted to equal levels of production per cow. Thirty-five of the 41 producers in the sample reported changes in herd sizes during the period studied. Because of the difficulty involv-

Table 1. Average production per cow, average butterfat tests, and composition of herds: 6 members of the Noxubee Milk Producers Association.

Item	Unit	Can system October 1955-July 1956	Bulk system October 1956-July 1957	Net change
Production per cow	lbs.	2,726	3,245	519[3]
Butterfat tests:				
Unadjusted	percent	4.60	4.48	— .12
Adjusted[1]	percent	4.55	4.52	— .03
Composition of herds:				
Jersey	no.	255	254	—1
Holstein	no.	28	29	+1
Guernsey	no.	8	8	----
Others[2]	no.	16	16	----

[1] Adjusted to an average level of production of 2,985.8 pounds per cow.

[2] Includes mixed breeds.

[3] Difference attributed to better pastures.

Table 2. Number of bacteria counts and average bacteria count per cubic centimeter of milk. 41 producers, Noxubee Milk Producers Association.

Item	Can system October 1955-July 1956	Bulk system October 1956-July 1957	Net change
Number of counts	1,228	771	— 457
Average bacteria count per cubic centimeter[1]	32,000	28,000	—4,000

[1] Eleven counts under the can system and four counts under the bulk system were too numerous to count. These were entered in the analysis at 500,000 per cubic centimeter.

Table 3. Facilities required to cool and store specified volumes of milk on the farm, can system and bulk system.

Daily production		Can system[1]		Bulk system[2]
Maximum	Average	Size of cooler	Number of cans	Size of tank
(Gallons)		(No. of cans)	(Number)	(Gallons)
20	15	4	4	100
40	30	4	8	100
60	45	6	12	150
80	60	8	16	200
100	75	10	20	250
120	90	10	24	300
140	105	12	28	350
160	120	14	32	400
180	135	8+10[3]	36	450
200	150	10+10[3]	40	500

[1] Every day pick-up with empty cans returned as milk is picked up.

[2] Every other day pick-up with reserve storage for one extra milking during flush season.

[3] Least-cost combination where capacity of one cooler is exceeded.

ed in adjusting the levels of production per cow, butterfat tests from the herds of these 35 producers were eliminated. Thus, the comparison of butterfat tests was based on only six herds in which no change in numbers occurred. This provides 60 observations for each system. (Appendix Table 1).

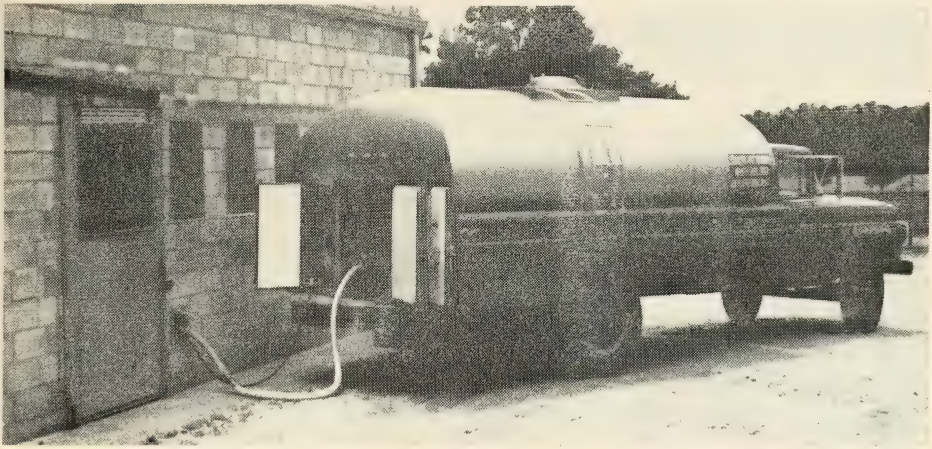
For these six, the average level of production per cow was 519 pounds higher during the time the bulk system was used than it was previously. When adjusted to an average level of production, the butterfat test under the can system was 4.55 percent, and under the bulk system, 4.52 percent (Table 1). The difference of .03 percent between the two was not statistically significant.

Bacteria counts: The bacteria counts used in this study were those made by the association for quality control purposes. The number of counts, average count per cubic centimeter, and differences in these items between can and bulk systems are shown in Table 2. A more detailed analysis is shown in Appendix Table 2.

Eleven counts under the can system and four under the bulk system were recorded as "too numerous to count"; these observations were entered in the analysis at 500,000 each. Another problem encountered was that bacteria counts for degraded milk were not recorded by the association. Because of these limitations, average bacteria counts shown for both systems are no doubt biased downward. In general, producers with high bacteria counts under the can system also had relatively high counts under the bulk system.

Facilities Required for Farm Storage and Cooling

Whether the producer uses a can cooler or a bulk tank, the size of facilities needed for farm storage and cooling of



From the bulk tank inside the barn the milk is pumped into a truck tank for delivery to the plant.

milk is determined by two factors—the maximum level of daily production and the frequency of milk pick-up. Route trucks usually pick up milk each day from farms where cans are used and return empty cans as milk is picked up. Thus, the producer with the can system must provide cooling space to hold his maximum daily volume, and cans for twice that volume. With the bulk system, routes are covered only once each two days. To allow for the possibility that the truck might not run on schedule, producers using bulk tanks must provide storage space for at least five milkings during the flush season.

Facilities required to cool and store specified maximum daily volumes of milk on the farm are summarized in Table 3.

Investment Requirements

On farms where bulk tanks can be installed without altering the milk room, the installed price of the tank will represent most, if not all, of the investment required to switch to bulk tanks. For direct-expansion tanks, these prices in 1957 ranged from about $1,500 for the 100-gallon size to about $3,500 for 500-gallon tanks. Installed prices for ice-bank tanks of corresponding sizes were from $200 to $300 less than those of direct-expansion tanks. Investment requirements for bulk tanks and can equipment, over a wide range of daily production maxima, are compared in Table 4.

As will be noted from the table, investment requirements of bulk tanks are considerably greater than for can equipment at any level of production. For the producer who converts from can to bulk system, however, a part of the investment may be recovered through the sale of his used can equipment. Average resale values of coolers and cans sold by Noxubee producers ranged from approximately $100 to $600, as shown in the latter part of the table above. Producers of manufacturing milk are the principal buyers of used can equipment. As more bulk tanks are installed, the market potential for coolers and cans will become more restricted and, as a consequence, resale values of can equipment are likely to become progressively smaller.

Cost Comparisons

To provide any producer, regardless of volume, with a basis for comparing cost expectations under the three systems, estimates of annual costs of owning and operating were made over a wide range of daily production volumes. Cost comparisons are summarized in Table 5.

Costs included in these estimates were of two types: equipment costs and operating costs. Equipment costs, i.e., depreciation, interest on investment and (in the case of bulk tanks) repairs are related to maximum daily production. Operating costs, especially those for electricity and labor are, on the other hand, more closely related to average than to maximum production. For these reasons, Appendix Tables 3-5, in which detail cost items are shown for the three systems, include both maximum daily and average annual production levels.

Equipment costs: Depreciation was calculated by the straight line method, with 10 percent of the purchase price of coolers and tanks being allowed as salvage value. For can equipment, an annual rate of 10 percent was used for coolers and 14 percent for cans. For bulk tanks, the annual rate was 6 2/3 percent. These rates were consistent with reported experiences and expectations of producers interviewed. Because of the price relationships, annual depreciation costs were least for can equipment and highest for direct-expansion tanks at all levels of production.

Interest on investment was charged at the rate of 5 percent on one-half of the purchase price of equipment.

Annual repair costs for can coolers, based on producer estimates, were not related to size of coolers. Therefore, the average of all repair estimates, $23, was applied for all coolers regardless of size. Added to this $23 was the cost of retinning 20 percent of the cans each year at $4 per can retainned. Because of their limited experiences with them, Noxubee producers had no basis for estimating annual repair costs for bulk tanks. An estimate of 1.5 percent of the purchase price of the tanks, as developed in a study in another area[1], was therefore used as a fair repair cost for bulk tanks.

The combined estimates for deprecia-

Table 4. Average installed prices for bulk tanks and can equipment, and resale values of used can equipment: Mississippi, 1957.

Item	Maximum daily production (gallons)[1]									
	20	40	60	80	100	120	140	160	180	200
Installed prices:										
Bulk tanks:										
Direct-expansion	1,543	1,543	1,784	2,108	2,300	2,625	2,850	3,099	3,300	3,485
Ice-bank	1,389	1,389	1,606	1,897	2,070	2,362	2,565	2,789	2,970	3,135
Can equipment:										
Cooler	387	387	473	559	645	645	731	817	1,204	1,290
Cans	40	80	120	160	200	240	280	320	360	400
Total	427	467	593	719	845	885	1,011	1,137	1,564	1,690
Resale value:										
Coolers	89	89	135	181	227	273	296	319	408	454
Cans	18	35	53	71	89	106	124	142	159	177
Total	107	124	188	252	316	379	420	461	567	631

Source: Table 3 and Appendix Tables 6, 7, 8, and 12.

[1] For sizes and amounts of equipment involved for each level of production see Table 3.

---

[1] Robert O. Sinclair, **Economic Effects of Bulk Handling of Milk in Vermont,** Vermont Agricultural Experiment Station Bulletin 581, Burlington, 1955, p. 19.

Table 5. Comparison of annual costs of cooling and storing milk on the farm with can coolers, direct-expansion tanks and ice-bank tanks, Mississippi.

Item	Maximum daily production (gallons)									
	20	40	60	80	100	120	140	160	180	200
	(Dollars)									
Equipment:[1]										
Can system	77	88	107	127	147	167	186	206	250	270
Direct-expansion tank	155	155	179	211	230	263	285	310	330	348
Ice-bank tank	139	139	160	189	207	236	256	279	297	313
Electricity (additional meter):[2]										
Can system	68	81	88	94	101	108	115	122	131	143
Direct-expansion tank	71	79	82	86	89	93	96	100	103	107
Ice-bank tank[3]	68	81	88	94	101	108	115	122	131	143
Cleaning materials:[4]										
Can system	73	80	86	93	100	107	114	120	127	133
Direct-expansion tank	68	75	80	[illegible]	91	98	103	109	113	120
Ice-bank tank[5]	68	75	80	86	91	98	103	109	113	120
Total excluding labor:										
Can system	218	249	281	314	348	382	415	448	508	546
Direct-expansion tank	294	309	341	383	410	454	484	519	546	575
Ice-bank tank	275	295	328	369	399	442	474	510	541	576
Labor:										
Can system	898	1,070	1,243	1,416	1,588	1,760	1,932	2,105	2,278	2,450
Direct-expansion tank	688	840	992	1,144	1,295	1,447	1,598	1,750	1,902	2,054
Ice-bank tank[5]	688	840	992	1,144	1,295	1,447	1,598	1,750	1,902	2,054
Total including labor:										
Can system	1,116	1,319	1,524	1,730	1,936	2,142	2,347	2,553	2,786	2,996
Direct-expansion tank	982	1,149	1,333	1,527	1,705	1,901	2,082	2,269	2,448	2,629
Ice-bank tank	963	1,135	1,320	1,513	1,694	1,889	2,072	2,260	2,443	2,630

Source: Appendix Tables 3 - 5.

[1] Includes depreciation, repair and interest on investment.

[2] For cost of electricity, if installed on house meter, see Appendix Tables 3 - 5.

[3] Same estimate as for can cooler.

[4] Includes cost of brushes, cleaner and sanitizer.

[5] Same estimate as for direct-expansion tank.

tion, interest and repair cost ranged from $77 to $270 for the can system. For direct expansion bulk tanks, these costs ranged from $154 to $348, and for ice-bank tanks, from $139 to $314. Estimates for the individual items at specified levels of production are shown in Appendix Tables 3-5 Estimating procedure is shown in Appendix Tables 6-8.

Electricity: When can coolers were used, electric consumption for both dwelling and barn was, on most farms, measured through the same meter. Because of the larger compressor motor on direct-expansion tanks, however, the utility company required separate meters for barns where tanks of that type were installed. Estimates of power consumption at barns where can coolers were used were obtained by comparing monthly records of kilowatt hours consumed through house meters for the two time periods studied, adjusted for changes in household electrical appliances. Utility company records of barn meter readings gave direct estimates of amounts of power used with direct-expansion tanks. The one ice-bank tank in this study was installed on the same meter as the dwelling, and was assumed to use the same amount of electricity as a can cooler of comparable size.

When can coolers were used, the average amounts of electricity used monthly at milking barns ranged from 318 to 1,593 KWH for farms with 15- and 200-gallon average daily production levels, respectively. With direct-expansion tanks and the same levels of production, the range of monthly power consumption averages was 340 to 995 KWH. Estimates of monthly power consumption at the barn, for specified levels of production, are shown in Table 6 for both types of equipment.

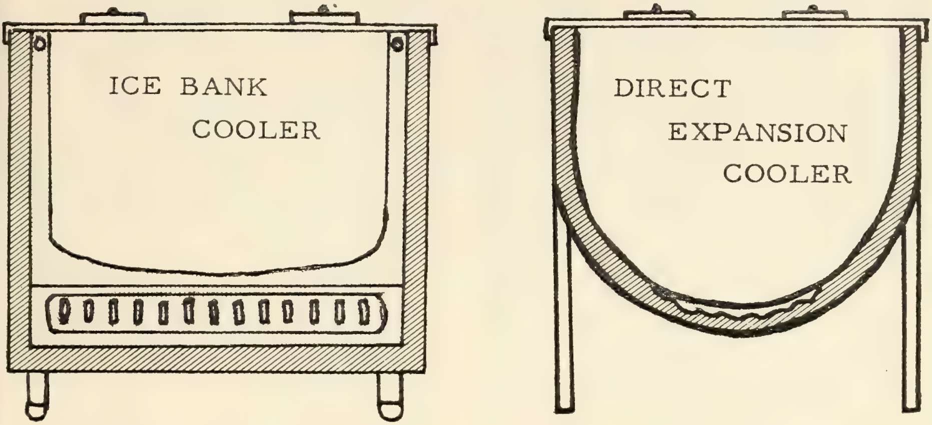
At the same rates per kilowatt hour, cost of electricity would have been considerably higher for can coolers than for direct-expansion tanks. The additional meter required for the latter, however, reversed these cost relationships. The average producer used 823 KWH of electricity a month for his dwelling alone. With a declining rate schedule, rates for additional electricity through that meter would have begun at four-tenths of one cent per KWH. On separate meters, the rate schedule begins at three cents per kilowatt.

Estimates of electricity costs for each system under both meter arrangements are shown in Appendix Tables 3 - 5. The rate schedule in effect at the time the study was made is shown in Appendix Table 9.

Cleaning materials: Brushes, cleaner and sanitizer were the cleaning materials for which costs were obtained. The cost of cleaning materials for the can system was higher than for the bulk system at each level of production. Costs increased with volume under each system but were about $4 to $12 less under the bulk system. Estimates for individual items are shown in Appendix Tables 3-5, and the estimating procedure is shown in Appendix Table 10.

Labor: Greatest saving offered by bulk tanks appeared to be in labor. Since cans were cleaned and sanitized at each milking and bulk tanks only every other day, considerably less labor was required under the bulk system (Table 7). The procedure for estimating labor requirements is shown in Appendix Table 10.

Labor was charged at an hourly rate of 50 cents. Since, on some farms, labor may not be considered a cost, the cost analysis in Table 5 also shows costs when no charge is made for labor.



Two types of bulk storage tanks were being used in the area studied. As these cross-sectional drawings illustrate, one type has ice and water between the coils and the milk while the other does not.

Table 6. Estimated monthly consumption of electricity at milking barns with can coolers and direct-expansion tanks.

Daily production		Can system	Bulk system (direct-expansion)
Maximum	Average		
(Gallons)		(Kilowatt hours)	
20	15	318	340
40	30	460	413
60	45	601	486
80	60	748	558
100	75	885	631
120	90	1,026	704
140	105	1,168	776
160	120	1,310	849
180	135	1,451	922
200	150	1,593	995

Table 7. Estimates of labor required annually to milk and clean equipment at specified levels of production, by type of cooling equipment.

Daily production		Can system	Bulk system	
Maximum	Average		Direct-expansion	Ice-bank[1]
(Gallons)			(Hours)	
20	15	1,796	1,377	1,377
40	30	2,141	1,681	1,681
60	45	2,486	1,984	1,984
80	60	2,831	2,287	2,287
100	75	3,175	2,590	2,590
120	90	3,520	2,894	2,894
140	105	3,865	3,197	3,197
160	120	4,210	3,500	3,500
180	135	4,555	3,804	3,804
200	150	4,900	4,107	4,107

[1] Same estimate as for direct expansion tank.

SUMMARY AND CONCLUSIONS

The purpose of this study was to provide some of the basic information needed to evaluate the feasibility of changing from the can system to the bulk system of cooling and storing milk on farms. The specific data provided are comparisons of butterfat tests, bacteria counts, and cost items for each system.

The study was based on the experiences of the Noxubee Milk Producers Association and 41 of its members. This association switched from the can system to the bulk tank system during the Fall of 1956.

Butterfat tests of each producer's milk under the can system were compared to comparable tests under the bulk system. There were no diffrences in butterfat tests that could be attributed to bulk tanks.

Bacteria counts of each producer's milk under the can system were compared to counts under the bulk system. The average bacteria count per centimeter was 28,000 under the bulk system and 32,000 under the can system. Some bacteria counts above 200,000 were recorded for each system. From the comparisons made, it was apparent that bacteria counts were more closely related to producers than to the system used.

Cost of cooling and storing milk under the can system versus the bulk system was evaluated for 10 levels of maximum daily production, ranging from 20 to 200 gallons. When labor was not considered as a cost item, cost for the can system was less than for the bulk system at each level of production. When labor was included as a cost item, cost for the can system was consistently higher than for the bulk system. The difference in annual cost between direct-expansion tanks and ice-bank tanks was insignificant, provided the same meter arrangement is used for each tank. However, where it is possible to install an ice-bank tank on the same electrical meter as the dwelling, operating costs for that type of tank may be considerably reduced.

The investment required to switch to a bulk tank ranged from about $1,500 to $3,500 for a direct-expansion tank. The investment for the ice-bank tank ranged from $200 to $300 less than for the direct-expansion tank. Part of the investment may be recovered through the sale of used can equipment. Sale values realized by members of the Noxubee Milk Producers Association ranged from $100 to $600. As bulk tanks are installed on Grade A farms, resale values of can equipment will no doubt decline.

Appendix Table 1. Covariance analysis of variation in butterfat tests under can and bulk systems for six members of Noxubee Milk Producers Association, Macon, Mississippi, October 1955 - July 1956 and October 1956 - July 1957.[1]

Source of variation	d.f.	Sums of squares and cross products			Errors of estimate		
		x^2	xy	y^2	Sums of squares	d.f.	Mean square
Total	119	1,017,553.64	—1,167.51	10.28125			
Between months	9	97,154.90	— 501.26	3.27375			
Between systems	5	80,937.06	— 194.78	.46875			
Between farms	1	558,133.72	— 149.86	3.63075			
Months x farms	45	125,686.70	— 90.41	1.33175			
Months x systems	9	31,333.78	— 10.20	.13375			
Farms x systems	5	47,247.69	— 81.13	.55475			
Months x farms x systems	45	77,059.79	— 139.87	.88775	.63569	44	.01413
Systems + error	46	157,996.85	— 334.65	1.35650	.64769	45	
Difference for testing systems					.01200	1	.01200

7 = .01200/ .01413 = .8492 (not significant)   Regression coefficient = —.00181

System	Average production per cow/10 months X	Average butterfat test Y	Adjusted butterfat
	(pounds)	(percent)	(percent)
Can system	2,726.1	4.6000	4.5530
Bulk system	3,245.5	4.4750	4.5220
Difference	— 519.4	.1250	.0310

[1] Analysis was limited to six producers who reported the same number of cows in each month.

Appendix Table 2. Analysis of variation in logarithmic counts of bacteria for 41 members of the Noxubee Milk Producers Association, Macon, Mississippi, October 1955 - July 1956 and October 1956 - July 1957.

Source of variation	SS	d. f.	MS	F
Total	136.0332	759	.1792	
Between months	9.7358	9	1.0817	98.3363**
Between farms	38.2477	37	1.0337	10.0456**
Between systems	.8031	1	.8031	1.6582ns
Months x systems	3.6861	333	.0110	.1068ns
Months x farms	31.3711	9	3.4856	33.8736**
Farms x systems	17.9202	37	.4843	4.7065**
Months x farms x systems	34.2692	333	.1029	

System	Average bacteria count per c.c.	Average logarithmic count
Can	32,125	4.50685
Bulk	27,659	4.44184

** Significant beyond the .01 level.   ns Not significant at the .05 level.

Appendix Table 6. Average purchase prices, estimated annual depreciation and average of annual repairs reported for can coolers, Mississippi, 1957.

Item	Size of cooler (can capacity)						
	4	6	8	10	12	14	16
			(Dollars)				
Purchase price	387	473	559	645	731	817	903
Annual depreciation[1]	35	43	50	58	66	74	81
Salvage value[1]	39	47	56	64	73	82	90
Annual repair	23	23	23	23	23	23	23

[1] Life of cooler estimated to be ten years with a salvage value of 10 percent of purchase price (average age of coolers at time of conversion was 5.07 years).

Appendix Table 3. Summary of estimated cost of cooling and storing milk on the farm with can coolers, Mississippi, 1957.

Cost items	Units	Maximum daily volumes (gallons)									
		20	40	60	80	100	120	140	160	180	200
Cooling & storage equip.:											
Depreciation[1]	$	40	46	59	73	86	100	113	126	159	172
Repairs[2]	$	26	30	33	36	40	43	46	49	52	56
Interest on investment	$	11	12	15	18	21	24	27	31	39	42
Electricity:											
Consumption per month	KWH	318	460	601	748	885	1,026	1,168	1,310	1,451	1,593
On house meter	$	15	22	30	43	55	68	81	94	106	119
On additional meter	$	68	81	88	94	101	108	115	122	131	143
Cleaning materials:											
Brushes	$	4	5	6	7	8	9	10	10	11	12
Cleaner	$	46	47	48	49	50	52	53	54	55	56
Sanitizer	$	23	28	32	37	42	46	51	56	61	65
Total excluding labor:											
On house meter	$	165	190	223	263	302	342	381	420	483	522
On additional meter	$	218	249	281	314	348	382	415	448	508	546
Labor, hours:	Hrs.	1,796	2,141	2,486	2,831	3,175	3,520	3,865	4,210	4,555	4,900
Cost @ 50c per hour	$	898	1,070	1,243	1,416	1,588	1,760	1,932	2,105	2,278	2,450
Total including labor:											
On house meter	$	1,063	1,260	1,466	1,679	1,890	2,102	2,313	2,525	2,761	2,972
On additional meter	$	1,116	1,319	1,524	1,730	1,936	2,142	2,347	2,553	2,786	2,996
Annual production[3]	Cwt	471	942	1,413	1,883	2,354	2,825	3,296	3,767	4,238	4,708

[1] Includes depreciation on can coolers and cost of replacing 14.11 percent of the cans each year.

[2] Includes repair on can cooler and cost of retinning 20 percent of the cans each year.

[3] Annual production is based on 75 percent of maximum daily production.

Appendix Table 4. Summary of estimated cost of cooling and storing milk on the farm with direct-expansion type bulk tanks, Mississippi, 1957.

Cost items	Units	Maximum daily volumes (gallons)									
		20	40	60	80	100	120	140	160	180	200
Cooling & Storage equip.:											
Depreciation	$	93	93	107	126	138	158	171	186	198	209
Repair	$	23	23	27	32	34	39	43	47	50	52
Interest on investment	$	39	39	45	53	58	66	71	77	82	87
Electricity:											
Consumption per month	KWH	340	413	486	558	631	704	776	849	922	995
On house meter	$	16	20	23	27	33	39	46	52	59	65
On additional meter	$	71	79	82	86	89	93	96	100	103	107
Cleaning materials:											
Brushes	$	1	2	2	2	2	3	3	3	3	4
Cleaner	$	42	45	47	50	52	55	57	60	62	65
Sanitizer	$	25	28	31	34	37	40	43	46	48	51
Total excluding labor:											
On house meter	$	239	250	282	324	354	400	434	471	502	533
On additional meter	$	294	309	341	383	410	454	484	519	546	575
Labor, hours:	Hrs.	1,377	1,681	1,984	2,287	2,590	2,894	3,197	3,500	3,804	4,107
Cost @ 50c per hour	$	688	840	992	1,144	1,295	1,447	1,598	1,750	1,902	2,054
Total including labor:											
On house meter	$	927	1,090	1,274	1,468	1,649	1,847	2,032	2,221	2,404	2,587
On additional meter	$	982	1,149	1,333	1,527	1,705	1,901	2,082	2,269	2,448	2,629
Annual production[1]	Cwt.	471	942	1,413	1,883	2,354	2,825	3,296	3,767	4,238	4,708

[1] Annual production is based on 75 percent of maximum daily production.

Appendix Table 5. Summary of estimated cost of cooling and storing milk on the farm with ice-bank type bulk tanks, Mississippi, 1957.

Cost items	Units	Maximum daily volumes (gallons)									
		20	40	60	80	100	120	140	160	180	200
Cooling & Storage equip.:											
Depreciation	$	83	83	96	114	124	142	154	167	178	188
Repair	$	21	21	24	28	31	35	38	42	45	47
Interest on investment	$	35	35	40	47	52	59	64	70	74	78
Electricity:[1]											
Consumption per month	KWH	318	460	601	743	885	1,026	1,168	1,310	1,451	1,593
On house meter	$	15	22	30	43	55	68	81	94	106	119
On additional meter	$	68	81	88	94	101	108	115	122	131	143
Cleaning materials:											
Brushes	$	1	2	2	2	2	3	3	3	3	4
Cleaner	$	42	45	47	50	52	55	57	60	62	65
Sanitizer	$	25	28	31	34	37	40	43	46	48	51
Total excluding labor:											
On house meter	$	222	236	270	318	353	402	440	482	516	552
On additional meter	$	275	295	328	369	399	442	474	510	541	576
Labor, hours:	Hrs.	1,377	1,681	1,984	2,287	2,590	2,894	3,197	3,500	3,804	4,107
Cost @ 50c per hour	$	688	840	992	1,144	1,295	1,447	1,598	1,750	1,902	2,054
Total including labor:											
On house meter	$	910	1,076	1,262	1,462	1,648	1,849	2,038	2,232	2,418	2,606
On additional meter	$	963	1,135	1,320	1,513	1,694	1,889	2,072	2,260	2,443	2,630
Annual production[2]	Cwt.	471	942	1,413	1,883	2,354	2,825	3,296	3,767	4,238	4,708

[1] Consumption of electricity to be the same as for can coolers.

[2] Annual production is based on 75 percent of maximum daily production.

Appendix Table 7. Average purchase prices, estimated annual depreciation and estimated annual repair for direct-expansion type bulk tanks, Mississippi, 1957.

Item	Size of tank (gallon capacity)										
	100	150	200	250	300	350	400	450	500	600	700
					(Dollars)						
Purchase price[1]	1,543	1,784	2,108	2,300	2,625	(2,850)	3,099	(3,300)	3,485	4,214	4,740
Depreciation[2]	93	107	126	138	158	171	186	198	209	253	284
Salvage value[2]	154	178	211	230	262	285	310	330	348	421	474
Annual repair[3]	23	27	32	34	39	43	46	50	52	63	71

[1] Installed price, 1957.

[2] Life of tanks estimated to be 15 years with a salvage value of 10 percent of purchase price.

[3] Based on 1.5 percent of purchase price.

Appendix Table 8. Average purchase price, estimated annual depreciation, and estimated annual repair for ice-bank bulk tanks, Mississippi, 1957.

Item	Size of tank (gallon capacity)										
	100	150	200	250	300	350	400	450	500	600	700
					(Dollars)						
Purchase price[1]	1,389	1,606	1,897	2,070	2,362	2,565	2,789	2,970	3,136	3,793	4,266
Depreciation[2]	83	96	114	124	142	154	167	178	188	228	256
Salvage value[2]	139	161	190	207	236	256	279	297	314	379	427
Annual repair[3]	21	24	28	31	35	38	42	45	47	57	64

[1] Installed price, 1957.

[2] Life of tanks estimated to be 15 years with a salvage value of 10 percent of purchase price.

[3] Based on 1.5 percent of purchase price.

Appendix Table 9. Electricity rates per kilowatt hour used to calculate the cost of power under the two systems of cooling milk; Noxubee Milk Producers Association, Macon, Mississippi, 1957.

Kilowatt hours consumed per month		Cost per kilowatt hour
First	50	3.00
Next	150	2.00
Next	200	1.00
Next	1,000	0.40
All over	1,400	0.75

Appendix Table 10. Relationship between specified cost items and volume of production for cans and bulk systems of cooling and storing milk, Noxubee Milk Producers Association, Macon, Mississippi, 1957.

System: Dependent variables		Constant terms	Regression coefficient	Independent variables
Can system:				
Annual cost of brushes	($) =	3.515	+ (.00185)	(Annual volume — cwt.)
Annual cost of cleaner	($) =	44.496	+ (.00252)	(Annual volume — cwt.)
Annual cost of sanitizer	($) =	18.144	+ (.01001)	(Annual volume — cwt.)
Electricity:				
Consumption per month	(KWH) =	176.45	+ (.03660)	(Monthly volume — lbs.)
Labor requirements	(Hrs.) =	1,451.08	+ (.73242)	(Annual volume — cwt.)
Bulk system:				
Annual cost of brushes	($) =	1.264	+ (.00049)	(Annual volume — cwt.)
Annual cost of cleaner	($) =	39.888	+ (.00529)	(Annual volume — cwt.)
Annual cost of sanitizer	($) =	22.255	+ (.00617)	(Annual volume — cwt.)
Electricity:				
Consumption per month	(KWH) =	267.27	+ (.01880)	(Monthly volume — lbs.)
Labor requirements	(Hrs.) =	1,073.98	+ (.64413)	(Annual volume — cwt.)

Appendix Table 11. Prices used to calculate cost of specified items for can and bulk systems, Mississippi, 1957.

Item	Unit	Price
Average price of cleaner	lb.	$ .24
Average price of liquid sanitizer	gal.	1.35
Average price of powder sanitizer	qt.	1.30
Average price of cans	ea.	10.00
Average price for retinning cans	ea.	4.00
Average price of brushes—can system	set	.80
Average price of brushes—bulk tank system	set	2.65

Appendix Table 12. Estimated sale value of coolers by size and age of can coolers, Macon, Mississippi Area, 1957.[1]

Age of cooler	Size of cooler						
	4	6	8	10	12	14	16
(Years)				(Dollars)			
		217	263	309	355		
1		201	247	293	339		
2		184	230	276	322		
3		168	214	260	306		
4		151	197	243	289		
5	89*	135	181	227	273	296*	319*
6		118	164	211	257		
7		102	148	194	240		
8		86	132	178	224		
9		69	115	161	207		
10		53	99	145	191		

[1] Estimating equation was: sale price = 79.133 + (23.013) (size) — (16.456)(age). Average of variables was: sale price, 195.69; size 8.69; age, 5.07.

*Estimates for these sizes at an average age of five years were extrapolated.

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Ten Years' Results in a Nitrogen Fertilizer-Plant Population Experiment With Corn

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

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TEN YEARS' RESULTS IN A NITROGEN FERTILIZER-PLANT POPULATION EXPERIMENT WITH CORN

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R. R. BRUCE and JOE O. SANFORD

Beginning with the early 1940's intensified research in fertilizer and management practices for corn developed new and greatly improved practices, particularly in the southern states. Production factors contributing to these more efficient methods include:

(1) Use of much higher rates of nitrogen.

(2) Application of mineral nutrients when needed. Such need frequently develops or increases when all other factors are optimum.

(3) Higher plant populations which are necessary to utilize the higher fertility levels.

(4) Hybrids adaptd to the area, most of which are prolific.

(5) Supplemental irrigation.

These production factors are highly inter-related, and maximum effectiveness is attained only when all of them are in proper combination.

These production practices have resulted in higher yields and more efficient production throughout the area. As reasonably typical of these trends, average yields of corn in Mississippi are shown in Table 1. While average yields since 1945 reflect the usual fluctuations with season, they have never been so low as the 1935-44 average, and in most years since 1948 they have shown an increase of approximately 50 percent. Supplemental irrigation has not been important among the production practices to date, although the irrigated acreage is increasing. Of the 1,614,000 acres of corn in Mississippi 100,835 acres received supplemental irrigation in 1955 (7).

While the effectiveness of these production methods has been amply demonstrated by field experiments, and while these methods have been rather widely adopted by progressive farmers, the long-time effects of these practices on soil properties have not been systematically studied. A study involving varying nitrogen rates and plant populations was made at State College, Mississippi, and is reported here. Some of these results have been reported earlier (4).

Procedure

The experiment was conducted on an area of Kaufman fine sandy loam, overwash phase. The experiment was begun in 1947 and was continued through 1956. The field has a slope of about 2 percent, and is thus not particularly susceptible to erosion.

The same treatments were superimposed on the same plots each year. The experiment was a 3 x 2 factorial involving three levels of nitrogen (0, 60, 120 pounds per acre) and two plant populations (4000, 12000 plants per acre). For the 60-pound-nitrogen treatments nitrogen from ammonium sulfate was applied at planting time, and for the 120-pound-nitrogen treat-

Table 1. Average yields of corn in Mississippi.

Period	State average yield of corn bu/acre
Average 1935-44	15.3
1945	19.0
1946	16.0
1947	16.5
1948	22.0
1949	20.5
1950	26.5
1951	21.5
1952	16.0
1953	22.0
1954	17.0
1955	30.0
1956	25.0
1957	25.0

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[1] Soil Scientists, Eastern Soil and Water Management Research Branch, Agricultural Research Service, U.S.D.A. in cooperation with the Mississippi Agricultural Experiment Station.

ments 60 pounds was applied as ammonium sulfate at planting time and 60 pounds as ammonium nitrate as sidedressing. Eighty pounds of P_2O_5 and 80 pounds of K_2O were applied to all treatments annually. Except in 1947 when an open-pollinated variety (Laguna) was grown, the experiment was planted in Dixie 17, which is a prolific hybrid. There were four replicates in randomized block arrangement.

In 1947 the soil contained 132 pounds of available (Truog) P_2O_5 per acre in the 0- to 6-inch layer and 103 pounds in the 6- to 12-inch layer. Levels of exchangeable potash were 240 and 184 pounds per acre in the corresponding soil layers.

In the eleventh year (1957) the experiment was planted to corn without any fertilizer to study cumulative effects of the ten years of treatment. Stands in 1957 were maintained at the same levels as in preceding years. The soil was sampled in the winter of 1956-1957 for the study of chemical and physical properties.

All chemical analyses of soil and plant material were made by AOAC methods (1). Bulk density was determined on undisturbed cores (8). Air-filled porosity of undisturbed soil cores was determined at 30 cm and 60 cm of water tension. Water-stable aggregates were determined after wet sieving on 0.25 mm sieve for 2 and 5 minutes respectively (6).

Shading was measured by photographing the shade pattern which corn leaves made on the ground between 9:00 and 9:30 a.m. on a bright July day. The area exposed was a rectangle 36 x 40 inches in area, whose corners were two adjoining hills of corn in each of two adjacent rows. The shaded proportion of the ground area was measured on each photographic print by a planimeter. Incident light was measured with a standard light meter.

Soil temperatures were measured at the 4-inch depth at 9:00 a.m., 11:00 a.m., 2:00 p.m. and 4:00 p.m.; and the average of these readings is termed the daily mean.

Changes in soil moisture were measured by use of Bouyoucos (2) blocks placed at depths of four inches, one foot, two feet, and three feet. Resistance readings were made four times each week during 1947, 1948, and 1949.

Results In First 10-Year Period

Yields

Yields of corn through the first 10-year period, when fertilizers were applied annually, are shown in Table 2. With the 4000-plant stand there was a mean response of 30.7 bushels of corn for the first 60-pound increment of nitrogen, however the second 60-pound increment had little additional effect. With this stand there were not enough plants to utilize nitrogen applications in excess of the 60-pound rate. With the 12000-plant stand each 60-pound increment of nitrogen was very effective. Comparing the no-nitrogen, 4000-plant treatment with the 120-pound-nitrogen, 12000-plant treatment there was a mean response of one bushel of corn for each 1.8 pounds of nitrogen.

The levels of yield fluctuated somewhat with the character of the season, and were particularly low in 1952 and 1954 which were the driest on record at State College. Among years with more favorable distribution of rainfall, yields on the various treatments did not vary widely. The highest yields generally were in the ninth year of the 10-year period, or in 1955.

Ears and Grain

The effects of treatments on some characters of ears and grain are shown in Table 3. Weight per ear, number of ears per plant, and crude protein in the grain were increased with each increment of nitrogen and reduced with the increase in plant population. Comparing the least-intensive with the most-intensive treatment, weight per ear and number of ears per plant were increased moderately while crude protein in the grain was raised by almost two percent. The effects of the treatments on ear size are also shown in Figure 1.

Table 2. Yields of corn in a nitrogen fertilizer-plant population experiment at State College, Mississippi. 1947-1956

Treatment		Acre yields of corn										
Nitrogen	Plants	1947	1948	1949	1950	1951	1952	1953	1954	1955	1956	Mean
lbs./acre	no./acre	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.	Bu.
0	4000	31.4	29.3	21.2	35.8	25.2	21.8	34.6	38.7	41.8	36.0	31.6
60	4000	54.3	71.4	64.5	68.9	52.4	54.1	58.9	60.9	71.4	66.3	62.3
120	4000	56.0	73.7	67.9	77.3	70.4	49.2	57.8	57.1	68.5	68.2	64.6
0	12000	22.4	36.3	33.7	47.6	30.8	24.1	45.9	42.7	55.2	41.4	38.0
60	12000	61.8	77.6	71.2	90.2	64.8	48.6	74.6	59.6	95.0	72.4	71.6
120	12000	96.2	103.4	100.4	121.8	96.0	68.1	97.4	83.3	125.8	92.1	98.5
Character of growing season					favorable		very dry		dry	very favorable		

Table 5. Yields and nutrients absorbed by corn in a nitrogen fertilizer-plant population experiment. State College, Mississippi—1948

Treatment		Nutrients absorbed by above-ground portion of crop								Corn yield bu/A.
Nitrogen lb/A.	Plants no/A.	Nitrogen lb/A.	Phosphorus lb/A.	Potassium[1] lb/A.	Calcium[1] lb/A.	Sulfur lb/A.	Magnesium lb/A.	Zinc lb/A.	Boron lb/A.	
0	4000	36.6	13.9	27.9	8.3	3.2	5.8	0.3	0.1	29.3
60	4000	80.7	24.1	46.4	15.4	5.8	9.8	0.4	0.1	71.4
120	4000	80.9	20.0	59.2	17.7	4.7	7.8	0.4	0.1	73.7
0	12000	45.0	18.2	47.7	16.3	4.3	8.2	0.4	0.1	36.3
60	12000	87.4	25.4	63.6	29.6	6.7	12.5	0.5	0.1	77.6
120	12000	141.5	36.1	82.5	34.1	8.7	16.5	0.7	0.2	103.4
Percent in grain		70	62	23	6	57	41	51	51	

[1] At early dent stage; the content at maturity was somewhat lower. All other nutrients were measured at maturity.

Table 6. Cumulative effects of 10 years' treatments on corn yields and soil properties.

Treatment (1947-56)		Measurements in eleventh year (1957)							pH of soil after			
		Corn yields	Nitrogen in soil		Organic carbon in soil		Bulk density		1st 6 years		2nd 4 years	
Nitrogen	Plants		0"-6"	6"-12"	0"-6"	6"-12"	0"-3"	3"-6"	0"-6"	6"-12"	0"-6"	6"-12"
lb/A.	no/A.	bu/A	%	%	%	%	gms/cc	gms/cc				
0	4000	24.5	0.06	0.06	0.60	0.65	1.22	1.52	5.8	5.9	6.4	6.4
60	4000	33.0	.06	.07	.67	.68	1.19	1.48	5.5	5.9	6.3	6.4
120	4000	45.5	.06	.06	.80	.73	1.19	1.35	5.2	5.7	6.0	6.1
0	12000	35.2	.06	.06	.71	.70	1.17	1.44	5.8	6.0	6.5	6.3
60	12000	37.6	.08	.07	.70	.70	1.22	1.38	5.5	5.9	6.3	6.2
120	12000	40.8	.06	.06	.68	.63	1.23	1.37	5.3	5.6	6.0	6.1
L.S.D. 5%		8.0	NS	NS	NS	NS	NS	*	0.3	0.3	0.14	NS
1%		11.0							0.4	0.4	0.19	

*Differences between means of nitrogen treatments were significant.

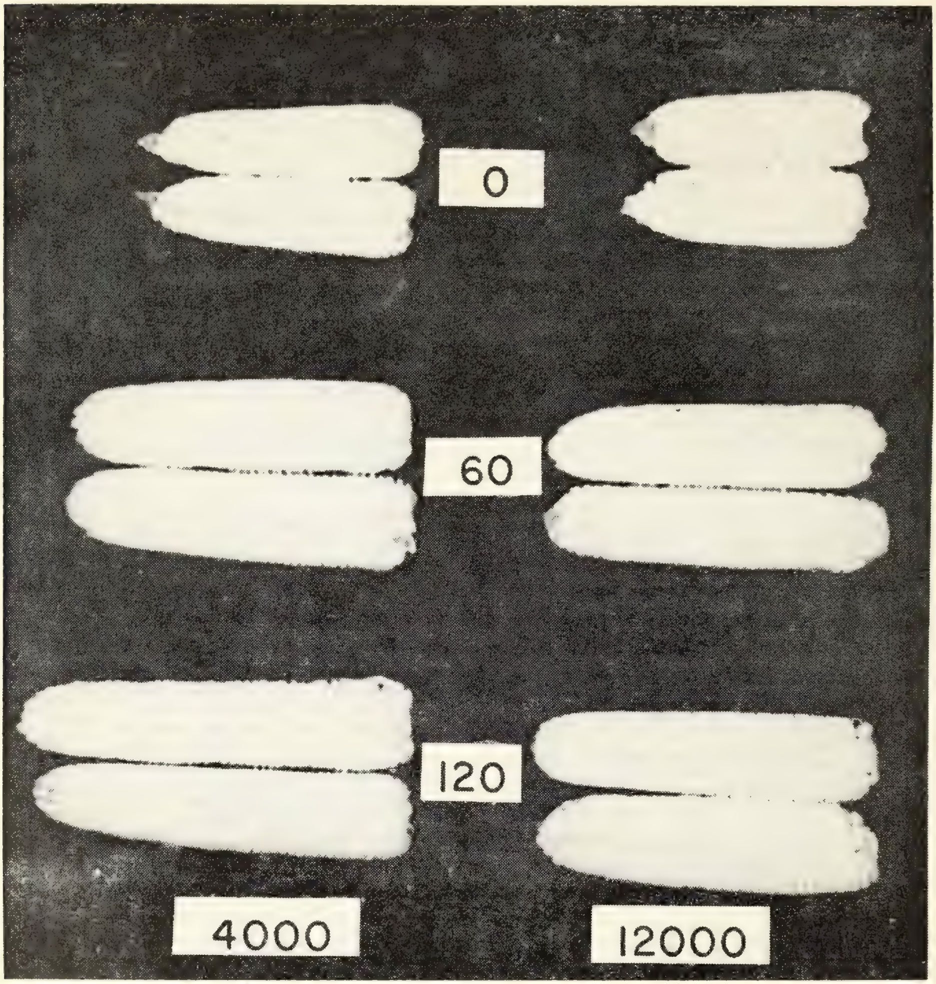

Figure 1. Size of ears as affected by nitrogen rate and plant population. Nitrogen applications of 0, 60 and 120 pounds per acre; plant populations of 4,000 and 12,000 per acre.

Crop Residues

The treatments also had a marked effect on weight and composition of corn stalks which constitute the crop residues for return to the soil (Table 4). Each increase in nitrogen and plant population caused an increase in both weight and nitrogen content of the corn stalks. Compared with the no-nitrogen, 4000-plant treatment, the 120-pound-nitrogen, 12000-plant treatment increased annual crop residues by more than two tons per acre and these residues contained an additional 23.5 pounds of nitrogen. This is probably important in the sustained productivity of soils cropped to corn under a high-fertility system. A view of the least intensive and most intensive treatments in the experiment is shown in Figure 2.

Shading

The amount of sunlight penetrating the vegetative canopy was markedly reduced by the more intensive cropping treatments. Measurements show that the ground area shaded ranged from 24 percent with the no-nitrogen, 4000-plant treatment to 62 per cent with the 120-pound-nitrogen, 12000-plant treatment. Incident light measured at ground level was only one-eighth as intense in shaded as in non-shaded areas.

As a result of the increased shade, weeds and grass were much depressed in the more intensive treatments. This is evident in Figure 2. Growing corn by these methods will eliminate at least one cultivation each year.

Soil Temperature

Accompanying the increased shading, and probably resulting from it, soil temperatures were lower under the more intensive treatments. Measurements at the 4-inch depth on a typical summer day show there was a reduction in daily mean temperature from 88.3° F. under the least intensive treatment of 83.8° F. under the most intensive treatment.

Water Requirements

There were pronounced differences in total water requirements of corn on the various treatments. It has been amply demonstrated that an increase in fertility will lower water requirements **per pound** of dry matter (5), but where increased fertility is accompanied by higher plant populations the water requirement **per acre** may be increased. This was true in this experiment as demonstrated by measurements of soil moisture. In 1948, for example, soil moisture at the 1-foot depth was exhausted by July 1 on the more intensive treatments and not until August 5 on the least intensive treatment. Available soil moisture at the 3-foot depth was exhausted by July 10 on the former treatments, while on the least intensive treatment available soil moisture was maintained at the 3-foot depth throughout the growing season.

The early and complete exhaustion of soil moisture in the surface three feet of soil by the 120-pound-nitrogen, 12000-plant treatment suggested that this treatment was near the upper permissable limit in cropping intensity, although the yield was 103.4 bushels per acre (1948, Table 2). The validity of this conclusion was confirmed in the very dry years of 1952 and 1954 when yields on the same treatment

Table 3. Effects of nitrogen and stand rates on ears and grain.

Treatment		Weight per ear	Ears per plant	Protein in grain (N x 6.25)
Nitrogen	Plants			
lb./A.	no./A.	lb.	no.	%
0	4000	0.40	1.13	8.2
60	4000	.49	2.10	9.8
120	4000	.50	2.13	10.9
0	12000	.22	0.69	7.6
60	12000	.34	1.10	8.7
120	12000	.43	1.28	10.0

Table 4. Dry weights and nitrogen contents of crop residues.

Treatment		Crop residues returned to soil annually	
Nitrogen	Plants	Dry weight	Nitrogen content
lb./A.	no./A.	lb./A.	lb./A.
0	4000	1737	8.6
60	4000	3842	19.3
120	4000	4093	20.1
0	12000	3024	13.0
60	12000	5325	21.6
120	12000	6405	32.1

were reduced to 68.1 and 83.3 bushels per acre respectively.

Growth Rates and Nutrient Uptake

Growth rates and uptake of N, P, and K for each of these treatments were measured in a parallel experiment, and these data have been published (3). Uptake of N, P, K, Ca, Mg, S, Zn, and B were measured in this experiment in 1948, and results are summarized in Table 5. In each case plants were sampled at five stages of growth; namely, knee-high, tassels emerging, roasting ear, early dent, and maturity. The samples were separated into leaves, stems, husks, cobs, and grain, and data obtained for each. Patterns of uptake, translocation, and distribution of nutrients among plant parts were generally the same in the 1948 study as in the published report (3).

It is of interest to compare the nutrients removed by the above-ground parts of a corn crop under the least- and most-intensive cropping systems included in this experiment. This comparison can be made from Table 5. The uptake of nitrogen was approximately quadrupled and that of phosphorus multiplied by 2.6. Further, these nutrients were predominantly removed in harvested grain. Requirements for nitrogen and phosphorus in continuous corn culture are high with this high-fertility treatment. The potassium balance is somewhat more favorable; while uptake was increased to approximately three fold only 23 percent of the potassium was removed in the harvested grain. These increased removals were counter-balanced by heavier rates of fertilization.

Uptake of calcium was approximately four times as great in the high-fertility system as in the low-fertility system, but 94 percent of the calcium was returned to the soil in crop residues. Uptake of sulfur was multiplied by 2.7, and only about 50 percent of the sulfur was localized in vegetative parts. Under good soil management the increased removal of calcium is ordinarily offset by calcium applied as lime and the greater demand for sulfur by that contained in fertilizer materials of ordinary grades or in supplemental applications.

This leaves magnesium, zinc, and boron, of the nutrients here considered, with the least favorable balance. Uptake of these nutrients was doubled or tripled, and about half of that taken up was removed in harvested grain. This might lead to deficiencies of these micronutrients under some soil conditions although none was encountered in this experiment. This was demonstrated on two extra plots which received the most intensive treatment and in addition a mixture of micronutrients including magnesium, zinc, and boron. No advantage was measured for the micronutrients.

Zinc deficiencies in corn occur on some neutral to alkaline soils in the Backlands and locally on some overlimed soils in Mississippi. Such deficiencies would be aggravated by a highly intensive cropping system. The micronutrients can be supplied with fertilizer where needed.

Effects of 10 Years of Treatment

In the eleventh year, when the experiment was planted without further fertilizer, the cumulative effects of past 10-year treatments caused an increase in yield of 16 bushels of corn per acre for the most intensive treatment. Yields are given in Table 6.

In spite of the range in volume and nitrogen content of crop residues returned to the soil each year, no significant differences in soil nitrogen or organic carbon were found in the eleventh year (Table 6). The climate at State College favors rapid decomposition of organic residues, and this probably precluded measurable accumulations in the soil. Nevertheless increased biological activity accompanying decomposition of the larger volume of residues may have contributed to greater

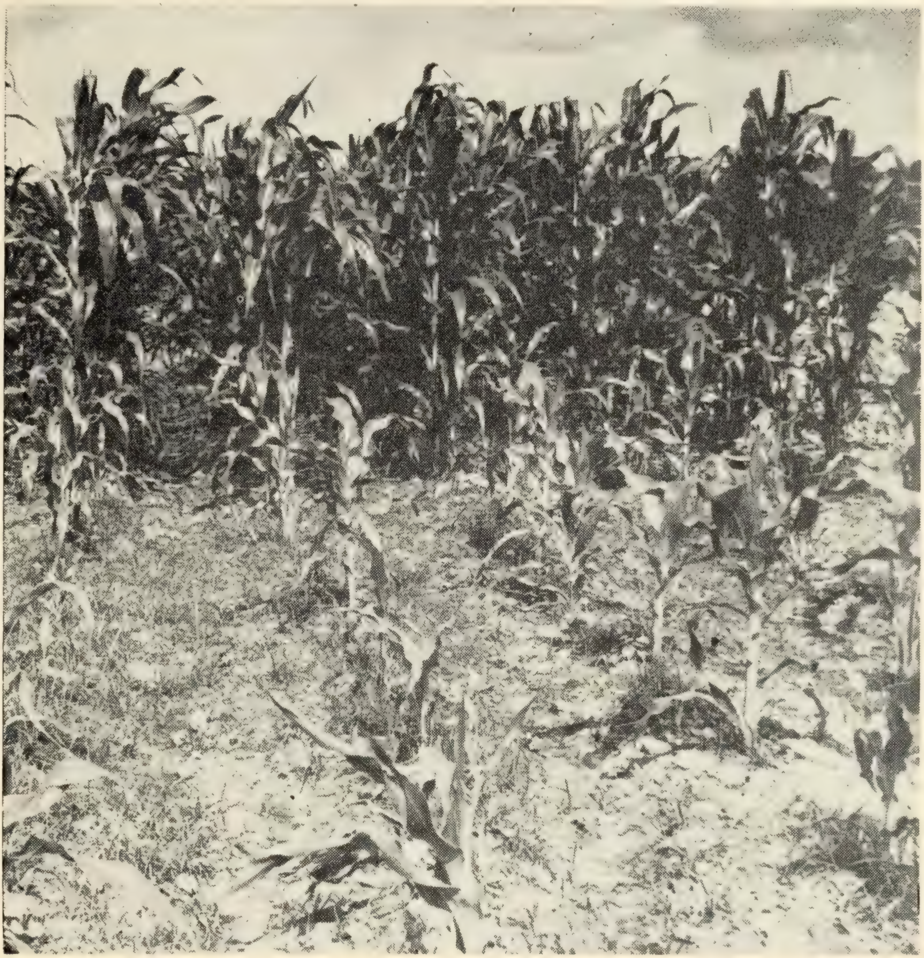

Figure 2. View of two treatments in the experiment, photographed June 30, 1949.

Plot in foreground received no nitrogen and had 4000 plants per acre. The yield was 21.2 bushels.

Plot in background received 120 pounds of nitrogen and had 12000 plants per acre. The yield was 100.4 bushels.

Note weeds and grass in the foreground; these were shaded out by corn in the background.

productivity in the more intensive treatments during the first ten years of the experiment.

The only measured difference in soil physical properties was a reduction in bulk density of the 3- to 6-inch soil (Table 6). Measurements of bulk density of the 0- to 3-inch soil, and air filled pores and water-stable aggregates of either 0- to 3- or 3- to 6-inch soil failed to show consistent differences among treatments.

The reduction in bulk density from 1.52 for the least-intensive to 1.37 for the most-intensive treatment reflects a significant increase in the volume of pores available for air and water movement and probably is a factor of some importance in ease of tillage.

One effect of the treatments was very consistent and pronounced. With each added increment of nitrogen there was a progressive increase in acidity of the surface soil. After 6 years, pH of the surface soil in the 120-pound-nitrogen treatments had reached a near-critical level, and the plots were relimed to a uniform pH 6.3. Following a second 4-year period (end of 10th year) the pH of the 120-pound-nitrogen plots had again declined by about one-half of a pH unit. The data are shown in Table 6.

This decline in pH of the soil resulted from the use of moderate to high rates of acid-forming nitrogen fertilizers and is not specifically associated with continuous cropping to corn. In any cropping system where acid-forming nitrogen materials are applied at rates comparable to those in this experiment, periodic reliming is essential if soils are to remain productive.

Discussion

During the first ten years of this experiment the 120-pound-nitrogen, 12000-plant treatment proved very effective. Compared with the least intensive treatment, which was common when the experiment was begun, there was an increase of 67 bushels of corn per acre, and the grain was almost two percent richer in crude protein. Crop residues were increased by more than two tons per acre, and one less cultivation was required each year. The study in the eleventh year was largely concerned with whether this efficiency had been achieved without exploiting soil resources.

Few reservations need be made. Intensive cropping may aggravate deficiencies of micronutrients on some soils, although it did not do so in this experiment. Continued application of moderate to high rates of acid-forming nitrogen fertilizers increased soil acidity and necessitated periodic liming.

Except for increased acidity, the soil of the most intensively cropped plots was in no measured respect depleted in comparison with the less intensively cropped soil. On the contrary a small, though definite, improvement in bulk density of soil in the plow layer was measured. In the year after fertilizer applications were discontinued cumulative benefits were responsible for a 16-bushel increase in yield.

The data indicate that corn can be grown almost continuously by these high-fertility practices under conditions similar to this experiment. Erosion was not a problem, and the fine sandy loam soil has a single grain structure not readily subject to deterioration. The results may not be applicable to erosive soils or those with unstable structure.

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Cotton Variety Tests, Hill Sections, Mississippi

1958

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COTTON VARIETIES IN HILL SECTIONS

By G. D. GREEN, J. F. O'KELLY, S. P. CROCKETT, B. C. HURT,
R. E. COATS and B. E. WAGGONER

Yields in the hill cotton variety tests varied considerably in 1958. This was due mostly to differences in rainfall and soils at the test locations. All tests received adequate fertilizer, were planted a week or two late for the location, received several applications of insecticide and none of them suffered from weeds.

The stand at the Brown Loam Branch Station at Raymond was erratic and so were the yields. For this reason, this test is not included in this report. Production on Flatwoods soil at the Pontotoc Ridge-Flatwoods Branch Station at Pontotoc were so irregular that yield records were not taken.

Explanation of Tables

Yield and other data may be seen in the accompanying tables. In these tables the term "LSD" means the least difference between varieties that is a real difference statistically. The term "CV" means coefficient of variation and the lower it is, the better the test.

The value per acre is in dollars and in the averages tables, it is based on Middling cotton.

A blank space in the yield columns means that the variety was not tested that year. For these varieties, the short term averages for lint percentage, staple length and bolls per pound of lint are included to give the reader some idea about these characteristics for the newer varieties.

Variety Selection

Deltapine SL is Deltapine Smooth Leaf and DES 1000 is Delta Branch Experiment Station Smooth Leaf. Seed of DES 1000 are not available commercially.

In selecting a variety, one should study the tables closely, particularly the ones showing results from the station with soil and conditions most nearly like his own.

The year by year performance is important. A variety close to the top every year is more desirable than one that is high one year and low the next.

Once a variety is selected, it should be planted several years, unless a better one comes along, to avoid the possibility of hitting the low years and missing the high ones. Low yields due to adverse conditions of any kind do not show the ability of a variety to produce.

All seed were obtained from the originator of the variety. The staple length is the average of the determinations of four professional classers each representing a different organization. Lint cotton prices used are averages of the Thursday quotations of the Memphis market beginning the last week in August. Seed were valued at $45 per ton.

Mr. Green succeeded Mr. O'Kelly on this cotton variety project when the latter retired as Experiment Station agronomist at State College. Mr. Crockett is at the North Mississippi Branch Station, Holly Springs; Mr. Hurt the Pontotoc Station, Pontotoc; Mr. Coats the Brown Loam Station, Oakley; and Mr. Waggoner the Coastal Plain Branch Station, Newton.

State College

Cotton Variety Averages, State College, Miss.

Variety	Yield per acre, pounds lint						Averages			
	1954	1955	1956	1957	1958	Average	Value per A	Lint %	Staple inches	Bolls per lb. lint
Empire	392.7	716.3	666.5	604.0	358.0	547.5	$218.61	36.1	1 1/32	167
Auburn 56	375.2	533.5	661.3	536.7	399.4	501.2	201.70	35.3	1 1/32	200
Fox	378.4	483.6	648.1	553.1	386.7	490.0	195.49	36.5	1 1/32	207
Plains	358.6	466.1	644.1	536.5	408.7	482.8	189.21	37.1	1 1/32	178
Deltapine 15	348.4	511.5	553.4	520.3	411.6	469.0	184.76	39.2	1 1/32	194
Delfos 9169	340.2	572.0	564.7	488.2	352.2	463.5	189.03	35.4	1 1/16	184
Coker Wilt	294.6	427.3	584.5	490.0	355.2	430.3	172.60	36.6	1 1/32	196
Dixie King	-------	621.2	600.7	582.2	403.5	-------	-------	36.8	1 1/16	158
Stoneville 3202	-------	504.6	594.9	543.6	405.4	-------	-------	38.3	1 1/32	188
DES 1000	-------	-------	720.8	613.5	469.7	-------	-------	41.1	1 1/32	167
Coker 124	-------	-------	613.8	492.4	332.2	-------	-------	36.8	1 3/32	177
Pope	-------	-------	664.1	545.2	465.1	-------	-------	39.3	1 1/32	174
Stardel	-------	-------	648.2	551.1	330.6	-------	-------	37.2	1 1/16	200
Stoneville 7	-------	-------	658.1	522.1	348.5	-------	-------	38.0	1 1/16	190
Deltapine SL	-------	-------	-------	607.7	440.6	-------	-------	39.3	1 1/16	186
Rex	-------	-------	-------	-------	430.1	-------	-------	35.2	1 1/16	177

Cotton Varieties.* State College, Miss., 1958.

Variety	Lbs. lint per acre	Total acre values in dollars			Lint percentage	Staple inches	Bolls per lbs. lint
		Middling	St. low middl'g	Low middling			
DES 1000	469.7	183.93	170.92	149.07	41.0	1 1/32	165
Pope	465.1	183.50	170.62	148.99	38.9	1 1/32	174
Deltapine SL	440.6	177.68	165.47	143.88	38.1	1 1/16	194
Rex	430.1	175.53	163.61	142.54	35.2	1 1/16	177
Deltapine 15	411.6	165.98	154.58	134.41	38.1	1 1/16	188
Plains	408.7	162.95	151.62	132.62	36.3	1 1/32	175
Stoneville 3202	405.4	160.76	149.53	130.68	37.6	1 1/32	187
Dixie King	403.5	160.80	149.62	130.86	36.4	1 1/32	156
Auburn 56	399.4	160.30	149.24	130.67	34.8	1 1/32	187
Fox	386.7	157.27	146.56	127.61	36.0	1 1/16	194
Empire	358.0	146.50	136.58	119.04	34.6	1 1/16	167
Coker Wilt	355.2	144.21	134.37	116.97	36.4	1 1/16	186
Delfos 9169	352.2	144.06	134.31	117.05	34.7	1 1/16	178
Stoneville 7	348.5	141.31	131.66	114.59	36.7	1 1/16	194
Coker 124	332.2	135.22	126.02	109.74	35.8	1 1/16	180
Stardel	330.6	134.23	125.07	108.87	36.4	1 1/16	203
L S D	45.5	-------	-------	-------	-------	-------	-------
CV, 12.4%							

SOIL: Verona fine sandy loam.

*Yields are low due to excessive miosture.

Holly Springs

Cotton Variety Averages, North Mississippi Branch Experiment Station, Holly Springs, Miss.

Variety	Yield per acre, pounds lint						Averages			
	1954	1955	1956	1957	1958	Average	Value per A	Lint %	Staple inches	Bolls per lb. lint
Fox	325.4	525.2	428.1	630.0	847.1	551.2	$214.78	37.5	1 1/32	235
Auburn 56	308.4	450.7	384.3	706.6	828.3	535.7	211.79	36.6	1 1/32	214
Plains	330.0	450.7	390.4	680.4	811.2	532.5	207.09	37.6	1 1/32	203
Delfos 9169	292.9	521.9	368.7	700.7	743.3	525.5	210.94	36.3	1 1/16	207
Deltapine 15	332.9	493.6	332.7	632.4	831.4	524.6	203.23	40.0	1 1/32	209
Empire	278.5	487.6	392.9	719.9	727.3	521.2	206.21	37.9	1 1/32	182
Coker Wilt	293.0	350.9	347.6	729.8	829.1	510.1	203.25	37.3	1 1/16	212
Stoneville 3202	-------	488.7	356.3	708.6	897.3	-------	-------	39.1	1	213
Dixie King	-------	517.7	426.7	737.9	761.3	-------	-------	38.0	1 1/32	175
Stoneville 7	-------	-------	427.1	693.6	948.1	-------	-------	41.0	1	198
DES 1000	-------	-------	402.5	683.7	897.8	-------	-------	42.4	1	194
Pope	-------	-------	401.9	743.7	892.1	-------	-------	41.5	31/32	205
Stardel	-------	-------	373.4	757.7	855.7	-------	-------	39.7	1 1/32	230
Coker 124	-------	-------	368.2	683.1	795.1	-------	-------	38.6	1 1/32	210
Deltapine SL	-------	-------	-------	715.3	849.3	-------	-------	41.0	1 1/32	197
Rex	-------	-------	-------	-------	657.5	-------	-------	39.0	1 1/32	184

Cotton Varieties, 1958, North Mississippi Branch Experiment Station, Holly Springs, Miss.

Variety	Lbs. lint per acre	Total acre values in dollars			Lint percentage	Staple inches	Bolls per lbs. lint
		Middling	St. low middl'g	Low middling			
Stoneville 7	948.1	360.54	332.00	292.56	42.0	1	186
DES 1000	897.8	339.33	312.31	274.96	43.9	1	167
Stoneville 3202	897.3	330.21	296.30	267.13	40.9	15/16	213
Pope	892.1	325.91	292.19	263.19	43.0	15/16	182
Stardel	855.7	336.01	312.20	272.51	40.2	1 1/32	216
Deltapine SL	849.3	322.86	297.29	261.96	42.1	1	186
Fox	847.1	324.64	299.14	263.90	39.8	1	198
Deltapine 15	831.4	315.42	290.40	255.81	42.7	1	189
Coker Wilt	829.1	324.99	302.03	263.47	40.7	1 1/32	189
Auburn 56	828.3	328.07	305.12	266.61	37.9	1 1/32	205
Plains	811.2	311.70	287.28	253.54	39.1	1	191
Coker 124	795.1	313.58	291.56	254.58	39.0	1 1/32	191
Dixie King	761.3	300.14	279.05	243.65	39.1	1 1/32	153
Delfos 9169	743.3	293.82	273.23	238.67	38.4	1 1/32	181
Empire	727.3	286.42	266.27	232.42	39.4	1 1/32	157
Rex	657.5	259.31	241.10	210.53	39.0	1 1/32	184
L S D	118.3	-------	-------	-------	-----	-------	-----
C V, 12.5%							

SOIL: Grenada silt loam.

Newton

Cotton Variety Averages, Coastal Plain Branch Experiment Station, Newton, Miss.

Variety	Yield per acre, pounds lint						Averages			
	1954	1955	1956	1957	1958	Average	Value per A	Lint %	Staple inches	Bolls per lb. lint
Auburn 56	257.7	416.6	383.1	508.4	270.1	367.2	$144.91	36.1	1 1/32	234
Plains	223.5	498.5	343.2	475.7	246.3	357.4	138.30	37.0	1	221
Coker Wilt	243.2	449.4	359.3	496.6	162.4	342.2	134.73	36.7	1 1/32	222
Empire	194.4	406.2	382.0	495.9	221.5	340.0	130.65	37.7	1	195
Fox	269.0	435.0	309.6	401.7	164.0	315.9	124.78	36.7	1 1/32	258
Delfos 9169	238.5	440.7	334.1	404.9	127.5	309.1	123.58	36.3	1 1/16	227
Deltapine 15	223.7	406.5	245.5	401.5	165.4	288.5	112.55	38.4	1 1/32	246
Dixie King	-------	509.0	400.1	486.6	219.9	-------	---------	37.7	1 1/32	173
Stoneville 3202	-------	505.8	325.3	485.4	211.6	-------	---------	38.8	1	225
Pope	-------	-------	397.3	540.0	250.3	-------	---------	40.1	1	207
DES 1000	-------	-------	368.4	494.9	192.7	-------	---------	40.9	1	204
Stoneville 7	-------	-------	388.6	461.5	180.5	-------	---------	38.6	1 1/32	222
Coker 124	-------	-------	325.0	455.0	198.8	-------	---------	36.9	1 1/32	210
Stardel	-------	-------	310.0	440.5	189.7	-------	---------	37.6	1 1/32	242
Deltapine SL	-------	-------	-------	398.3	204.1	-------	---------	38.5	1 1/32	206
Rex	-------	-------	-------	-------	295.3	-------	---------	35.8	1 1/16	171

Cotton Varieties,* 1958, Coastal Plain Branch Experiment Station, Newton, Miss.

Variety	Lbs. lint per acre	Total acre values in dollars			Lint percentage	inches Staple	Bolls per lbs. lint
		Middling	St. low middl'g	Low middling			
Rex	295.3	120.21	112.03	97.56	35.8	1 1/16	171
Auburn 56	270.1	108.77	101.28	88.73	34.1	1 1/32	199
Pope	250.3	98.91	91.97	80.34	38.5	1 1/32	177
Plains	246.3	100.22	93.40	81.33	35.9	1 1/16	178
Empire	221.5	88.98	82.85	72.55	34.6	1 1/32	166
Dixie King	219.9	89.48	83.39	72.61	35.9	1 1/16	160
Stoneville 3202	211.6	83.75	77.89	68.05	38.1	1 1/32	195
Deltapine SL	204.1	82.27	76.62	66.62	38.2	1 1/16	201
Coker 124	198.8	82.01	76.41	66.17	35.8	1 3/32	190
DES 1000	192.7	75.62	70.28	61.32	40.4	1 1/32	186
Stardel	189.7	76.39	71.80	62.50	36.3	1 1/16	215
Stoneville 7	180.5	73.04	68.04	59.20	37.2	1 1/16	204
Deltapine 15	165.4	66.85	62.27	54.17	37.5	1 1/16	214
Fox	164.0	65.58	61.04	53.41	35.6	1 1/32	205
Coker Wilt	162.4	66.08	61.58	53.63	35.9	1 1/16	189
Delfos 9169	127.5	52.86	49.26	42.69	34.7	1 3/32	196
L S D	43.6	---------	---------	---------	-----	----------	-----
CV, 18.3%							

SOIL: Stough loam.

*Yields considered low due to excessive moisture.

Pontotoc Ridge

Cotton Variety Averages, Pontotoc Ridge, Pontotoc Branch Experiment Station

	Yield per acre, pounds lint						Averages			
Variety	1954	1955	1956	1957	1958	Average	Value per A	Lint %	Staple inches	Bolls per lb. lint
Plains	221.0	639.5	355.2	530.7	749.3	499.1	$197.29	36.8	1 1/32	199
Auburn 56	221.0	609.0	379.6	550.1	716.8	495.3	196.86	36.1	1 1/32	213
Empire	227.2	619.1	287.5	543.2	656.8	466.8	184.71	37.2	1 1/32	170
Coker Wilt	203.2	565.0	307.9	514.3	738.5	465.8	185.15	36.1	1 1/32	204
Fox	241.1	552.8	271.0	560.1	677.1	460.4	182.24	36.5	1 1/32	227
Delfos 9169	233.9	575.6	270.0	434.6	580.7	419.0	169.12	35.7	1 1/16	202
Deltapine 15	181.0	484.8	292.2	481.9	606.7	409.3	159.41	38.3	1 1/32	218
Dixie King	-------	601.5	330.0	614.6	707.0	-------	-------	37.0	1 1/16	160
Stoneville 3202	-------	636.0	276.8	551.5	737.3	-------	-------	38.5	1 1/32	196
DES 1000	-------	-------	400.0	593.7	802.8	-------	-------	41.1	1	178
Pope	-------	-------	401.2	546.5	734.4	-------	-------	39.5	1	182
Stoneville 7	-------	-------	309.7	486.2	675.7	-------	-------	38.3	1 1/32	200
Stardel	-------	-------	258.3	516.1	707.7	-------	-------	38.1	1 1/32	204
Coker 124	-------	-------	271.0	484.1	646.8	-------	-------	37.1	1 1/16	184
Deltapine SL	-------	-------	-------	473.9	737.2	-------	-------	40.1	1 1/32	180
Rex	-------	-------	-------	-------	763.0	-------	-------	39.1	1 1/16	145

Cotton Varieties, Pontotoc Ridge, 1958, Pontotoc Branch Experiment Station.

		Total acre values in dollars					
Variety	Lbs. lint per acre	Middling	St. low middl'g	Low middling	Lint percentage	Staple inches	Bolls per lbs. lint
DES 1000	802.8	312.11	289.87	252.54	43.2	1 1/32	149
Rex	763.0	306.53	285.40	248.01	39.1	1 1/16	145
Plains	749.3	302.04	281.28	244.57	38.2	1 1/16	157
Coker Wilt	738.5	297.58	277.12	240.93	38.3	1 1/16	153
Stoneville 3202	737.3	289.00	268.58	234.30	40.7	1 1/32	167
Deltapine SL	737.2	294.80	274.38	238.26	40.4	1 1/16	167
Pope	734.4	287.29	266.94	232.79	41.3	1 1/32	157
Auburn 56	716.8	289.28	269.43	234.30	37.9	1 1/16	160
Stardel	707.7	283.30	263.70	229.02	40.1	1 1/16	169
Dixie King	707.0	287.93	267.99	231.58	39.1	1 3/32	133
Fox	677.1	272.02	253.27	220.09	39.1	1 1/16	158
Stoneville 7	675.7	270.49	251.77	218.66	40.1	1 1/16	170
Empire	656.8	264.92	246.73	214.54	38.0	1 1/16	143
Coker 124	646.8	263.13	244.89	211.58	39.4	1 3/32	151
Deltapine 15	606.7	238.07	221.26	193.05	40.4	1 1/32	171
Delfos 9169	580.7	238.29	221.91	192.00	37.1	1 3/32	161
L S D	89.3	-------	-------	-------	-----	-------	-----
C V, 11.0%							

SOIL: Atwood silty clay loam.

Cotton Variety Averages, Flatwoods, Pontotoc Branch Experiment Station, Pontotoc, Miss.

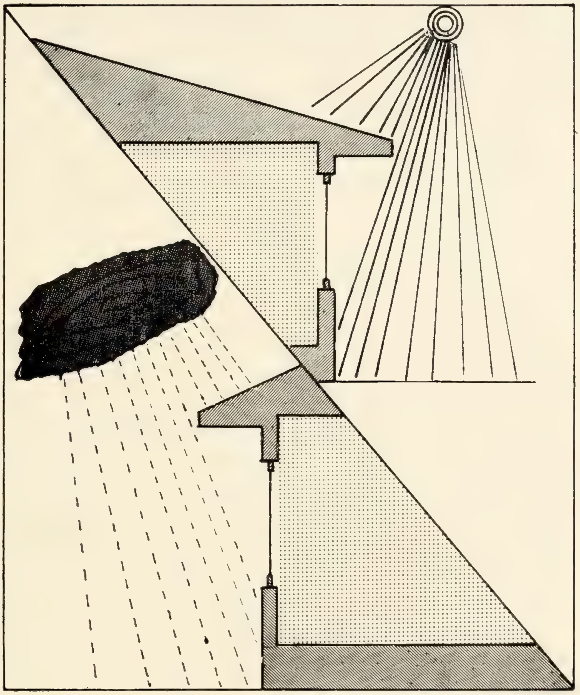
Flatwoods	Yield per acre, pounds lint				Averages			
Variety	1954	1955	1956	Ave.	Value per A	Lint %	Staple inches	Bolls per lb. lint
Auburn 56	208.3	522.6	348.5	359.8	$136.36	36.7	31/32	245
Empire	190.4	555.9	326.9	357.7	133.19	38.7	31/32	196
Plains	190.6	530.0	350.3	357.0	132.65	38.0	15/16	222
Delfos 9169	169.9	511.6	323.2	334.9	128.15	37.1	1	219
Hi-Bred	166.6	505.5	322.8	331.6	112.55	40.3	27/32	211
Deltapine 15	142.3	507.0	324.2	324.5	116.59	39.8	15/16	251
Coker Wilt	154.6	505.8	310.8	323.7	121.94	36.4	31/32	260
Fox	169.0	470.8	285.6	308.5	117.25	36.6	31/32	295
Dixie King	--------	564.9	340.3	--------	--------	38.6	31/32	177
Stoneville 3202	--------	512.2	332.3	--------	--------	40.3	15/16	212
DES 1000	--------	--------	337.3	--------	--------	40.4	15/16	230
Stoneville 7	--------	--------	318.8	--------	--------	39.7	31/32	247
Coker 124	--------	--------	313.6	--------	--------	38.8	31/32	218
Pope	--------	--------	304.7	--------	--------	39.1	31/32	229
Stardel	--------	--------	296.1	--------	--------	37.3	1	261

Cotton Variety Averages, Brown Loam Branch Experiment Station, Raymond, Miss.

Raymond	Yield per acre, pounds lint				Averages			
Variety	1955	1956	1957	Ave.	Value per A	Lint %	Staple inches	Bolls per lb. lint
Auburn 56	758.8	496.9	983.1	746.3	$298.00	35.2	1 1/16	208
Empire	702.3	549.7	864.5	705.5	276.04	37.4	1 1/32	158
Hi-Bred	710.5	554.8	739.7	668.3	232.80	40.3	29/32	152
Dixie King	713.8	552.0	734.8	666.9	260.30	37.0	1 1/32	160
Plains	781.0	502.0	694.0	659.0	256.03	36.8	1 1/32	194
Deltapine 15	815.8	402.6	735.0	651.1	255.10	38.6	1 1/32	204
Coker Wilt	715.3	474.5	753.9	647.9	259.60	35.6	1 1/16	203
Fox	773.2	400.6	756.4	643.4	252.04	36.7	1 1/32	221
Stoneville 3202	736.2	461.0	728.6	641.9	239.45	38.4	31/32	209
Delfos 9169	745.4	414.5	599.2	586.4	237.47	36.1	1 3/32	194
Pope	--------	500.8	836.2	--------	--------	40.0	1	208
Coker 124	--------	461.0	812.9	--------	--------	37.4	1 1/32	202
DES 1000	--------	497.5	744.5	--------	--------	41.6	1	188
Stoneville 7	--------	442.5	741.4	--------	--------	38.7	1	210
Stardel	--------	362.5	811.9	--------	--------	38.6	1 1/32	235
Deltapine SL	--------	--------	869.4	--------	--------	38.6	1 3/32	189

BULLETIN 572 FEBRUARY 1959

Effects of Roof Overhang



On Inside Temperatures And Rain Protection Of Walls

MISSISSIPPI STATE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

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JUN 11 1959

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SUMMARY

Width of roof overhang had very little effect on temperatures inside the test houses.

The wider the roof overhang the more the outside walls were protected from rain, but a 36-inch overhang did not completely protect the entire wall of a one-story home from all rains.

Some building materials absorbed more radiant heat energy than others, and therefore caused higher inside temperature.

The inside temperatures were higher in a house with the outside surface painted a dark color than when the surface was painted white, provided the same material and method of construction were used in the wall.

Both the east and west walls received more radiant heat from the sun per unit of area than the south wall. Therefore, they should be given more protection from the sun so as to help keep the inside of the house cooler.

Screening materials can be used to reduce the amount of radiant heat energy passing through windows, but they will also affect the amount of light passage.

These results and conclusions are for a latitude of 33½° and with the amount of window and door area specified.

FOREWORD

This publication is a report of research carried on by the Agricultural Engineering Department of the Mississippi Agricultural Experiment Station, Mississippi State University.

This research was set up in 1954 as part of the Southern Regional Housing Project S-8.

ACKNOWLEDGEMENT

The author acknowledges with appreciation the members of the Agricultural Engineering Department, Mississippi State University, who were helpful in setting up and carrying out the work on the project.

Effects of Roof Overhang on Inside Temperature and Rain Protection of Walls

By JACK GRIFFIN

Roof overhang on rural houses varies from about six inches up to about three feet. Owners offer various reasons for the particular width of overhang for their houses. Some of the most frequent ones are: (1) The width was specified in the building plan of the house desired; (2) the belief that a wide roof overhang will keep the inside of the house cooler during the summer; (3) an attempt to protect the outside walls and windows from the rains and (4) a desire to improve the appearance of the house.

The home owner who pays for a wide roof overhang expects to get some benefits from this additional expense but there has been very little research information available on the subject.

The objectives of this study were to determine: (1) What effect the width of roof overhang has on temperatures inside houses when different materials and colors are used on outside walls and (2) how much protection from rain the roof overhang gives outside walls and windows.

PROCEDURE

Field tests were begun in 1955 to determine if the width of the roof overhang had any effect on the temperatures of the inside air, the outside and inside surface of the exposed walls of a building, and on the amount of rain that would reach the surface of the exposed walls.

In these tests five different materials were used for covering the outside surfaces. These materials were (1) cement-asbestos shingles, (2) concrete block, (3) brick veneer, (4) asphalt shingle and (5) insulated fiber board.

The color of these materials was also varied. White and dark green were used on the asbestos shingle and concrete block walls. Red brick and the bricks painted white were used on the brick veneer. White was the only color used on the asphalt shingle and fiber board walls.

Three different widths of roof overhang were used: 12 inches, 24 inches, and 36 inches. The roofs were constructed on some of the houses so that the width of overhang could be varied.

The test houses were identical as to shape, size, orientation, type of roof, color of roof, and floor. The only differences were the kind or color of covering materials for the outside walls and the width of roof overhang. The test houses were 12 feet wide and 18 feet long and oriented so as to have the long axis in an east-west direction. They had hip roofs with attic vents and concrete slab floors. The houses had 29% of the floor area in window or exposed door area. Windows and door glass were covered with woven aluminum wire screens on the outside and windows had a white color shade covering the top sash on the inside.

To get the average wall surface temperature, thermocouples were placed at 21, 42, 63, and 84 inches above the floor level on the outside surface and 30 and 66 inches above floor level on the inside surface of the exposed walls. A recording thermometer was used in each house to record the inside air temperature.

Mr. Griffin is assistant agricultural engineer for the Experiment Station at Mississippi State University. This report is part of a regional project. See page 4.

The instruments were placed at the center of the room, 36 inches above floor level.

Wood blocks 3" x 5", with as near the same density as could be obtained, were fastened to the outside walls at the same heights as the thermocouples. These blocks were used to determine the relative amount of the rain reaching different heights of the walls. Moisture content of the blocks was taken soon after rains.

Temperatures were obtained from the thermocouples by means of a potentiometer at two-hour intervals between 8 a. m. and 6 p. m. on days in which the sun was shining for the period extending from the middle of June to the first of September. This is the critical period for high temperatures inside the house due to solar heat in this area.

A radiation meter was used to measure the amount of radiant energy striking the four walls of each house under the three different widths of overhang. Readings were taken at the same four heights as the thermocouples.

Shielded globe thermocouples were used to measure the relative amount of radiation being transmitted by the inside surface of the east and west outside walls. These two walls were used because they had the highest inside surface temperature.

In order to study the year-round performance of the materials and colors of materials, the houses were heated for a period during the winter. The amount of electric energy to maintain an inside air temperature of 70°F, the inside air and inside surface of the exposed wall temperatures were measured during the heating period.

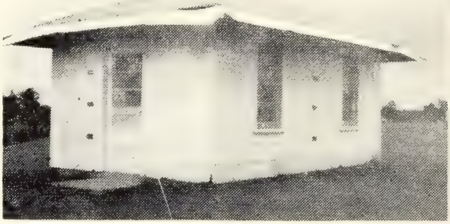


Figure 1. Test House A showing wide roof overhang and location of wood blocks to measure rain protection.

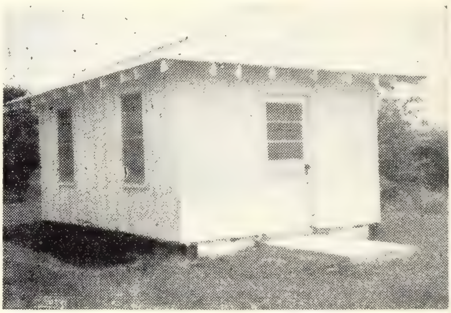


Figure 2. Test House F with insulated fiber board walls.

Figure 3. Test House G with brick veneer walls painted white.

To simplify discussion the houses were designated by letters, according to the following code:

House A, white asbestos shingles
House B, green asbestos shingles
House C, white concrete block
House D, red brick veneer
House E, white asphalt shingles
House F, white fiber board
House G, white brick veneer
House H, green concrete block

RESULTS AND CONCLUSIONS

Width of Roof Overhang on Temperatures

The average temperatures of the inside air and the outside and inside surface of the walls using the different widths of roof overhang are given in figures 4, 5, 6, 7 and 8.

Although the wider overhang gave a lower temperature on the walls it had very little effect on temperature of the air inside the houses. There was some difference in the inside surface temperatures due to width of roof overhang but not enough to affect the comfort inside the room to any great extent. The differential between the temperatures of the outside surfaces was not as great as might be expected.

The critical period average temperature for the outside surface of the east, west and south walls are also given in figues 4, 5, 6, 7 and 8. These critical periods were taken as follows: 8:00 a. m. to 10 a. m. for the east wall, 10:00 a.m. to 2:00 p.m. for the south wall, and 2:00 to 6:00 p.m. for the west wall. These temperatures are much higher than the average overall daily (8:00 a.m. to 6:00 p.m.). This figure gives a much better indication of the amount of heat being received by the wall during the period the overhang should do some good.

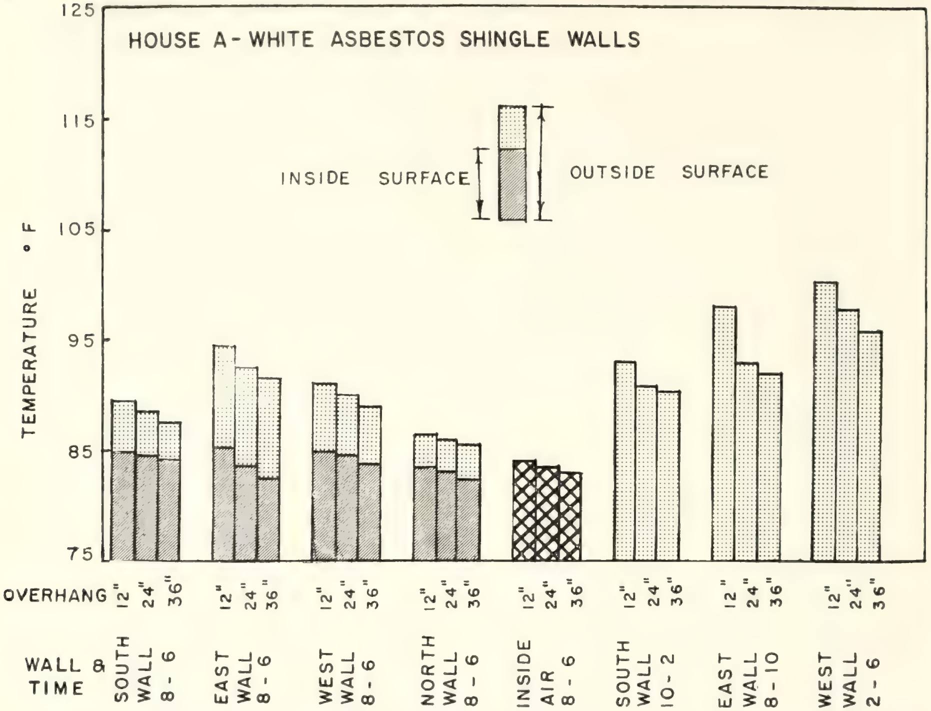
The average amount of solar radiation being received by the different walls during a period in mid-summer is given in table 1. From this it can be seen that the east and west walls receive much more radiation during their critical time period than does the south wall.

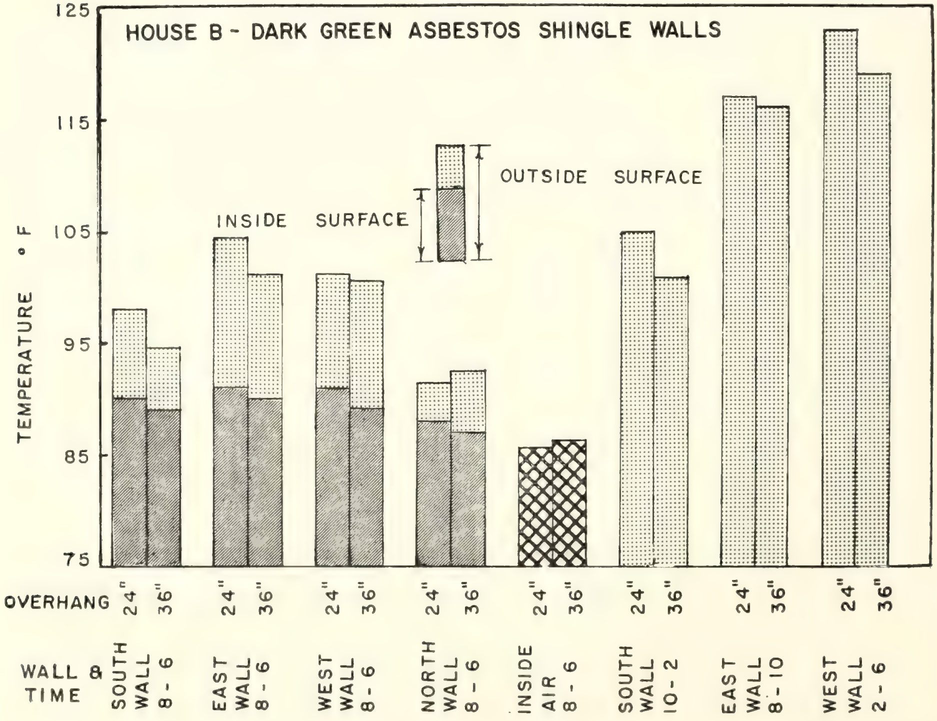
Even though the entire south wall of the house was not shaded by a 12-inch width of roof overhang, the sun's rays were striking the surface of the wall at such a great angle that there was very little more normal radiation being received by the unshaded portion than there was by the shaded portion of the wall. At 12 noon on one particular day when the radiation measurements were taken there were 66.3 BTU's/sq. ft. of normal radiation on the south wall where the sun rays were striking

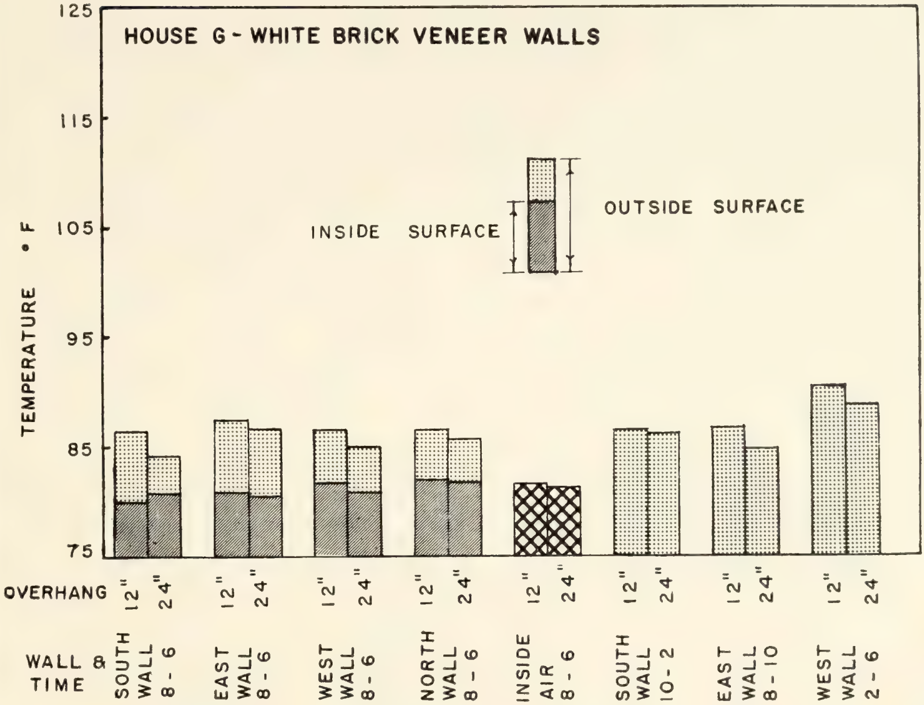
Table 1. Average amount of normal radiation being received by the different walls during a period in mid-summer.

Wall	Roof Over-Hang	Time Of Day					
		8 a.m.	10 a.m.	12 n	2 p.m.	4 p.m.	6 p.m.
	12"	271.8*	77.4	42.0	26.5	19.9	2.2
EAST	24"	203.3	55.3	35.4	26.5	15.5	2.2
	36"	145.9	42.0	26.5	22.1	13.3	2.2
	12"	22.1	37.6	48.6	48.6	30.9	2.2
SOUTH	24"	22.1	35.4	35.4	35.4	22.1	2.2
	36"	19.9	26.5	30.9	26.5	19.9	2.2
	12"	19.9	28.7	42.0	126.0	271.8	145.9
WEST	24"	17.7	26.5	35.4	81.8	198.9	143.7
	36"	15.5	22.1	28.7	70.7	154.7	132.6
	12"	39.8	33.2	33.2	30.9	26.5	42.0
NORTH	24"	24.3	30.9	28.7	28.7	22.1	44.2
	36"	19.9	24.3	24.3	24.3	17.7	42.0

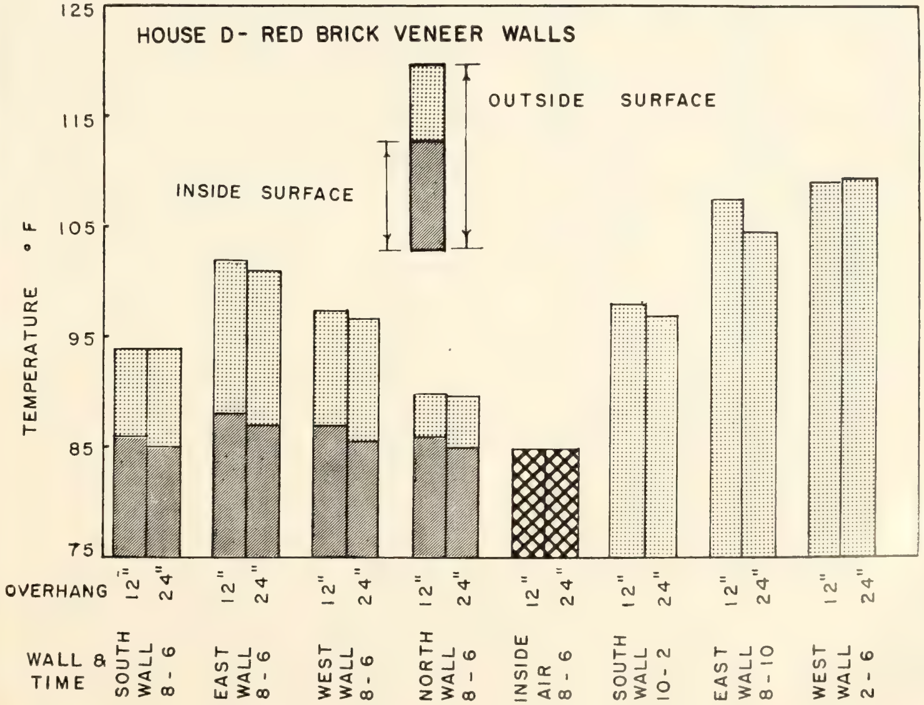
*Radiation in BTU sq. ft.


HOUSE A - WHITE ASBESTOS SHINGLE WALLS
INSIDE SURFACE
OUTSIDE SURFACE
TEMPERATURE °F
125
115
105
95
85
75
OVERHANG
12" 24" 36"
WALL & TIME
SOUTH WALL 8 - 6
EAST WALL 8 - 6
WEST WALL 8 - 6
NORTH WALL 8 - 6
INSIDE AIR 8 - 6
SOUTH WALL 10 - 2
EAST WALL 8 - 10
WEST WALL 2 - 6


HOUSE B - DARK GREEN ASBESTOS SHINGLE WALLS
INSIDE SURFACE
OUTSIDE SURFACE
TEMPERATURE °F
125
115
105
95
85
75
OVERHANG
24" 36"
WALL & TIME
SOUTH WALL 8 - 6
EAST WALL 8 - 6
WEST WALL 8 - 6
NORTH WALL 8 - 6
INSIDE AIR 8 - 6
SOUTH WALL 10 - 2
EAST WALL 8 - 10
WEST WALL 2 - 6



Figures 4 & 5. Effect of color on asbestos shingle walls.



Figures 6 & 7. Effect of color on brick veneer walls

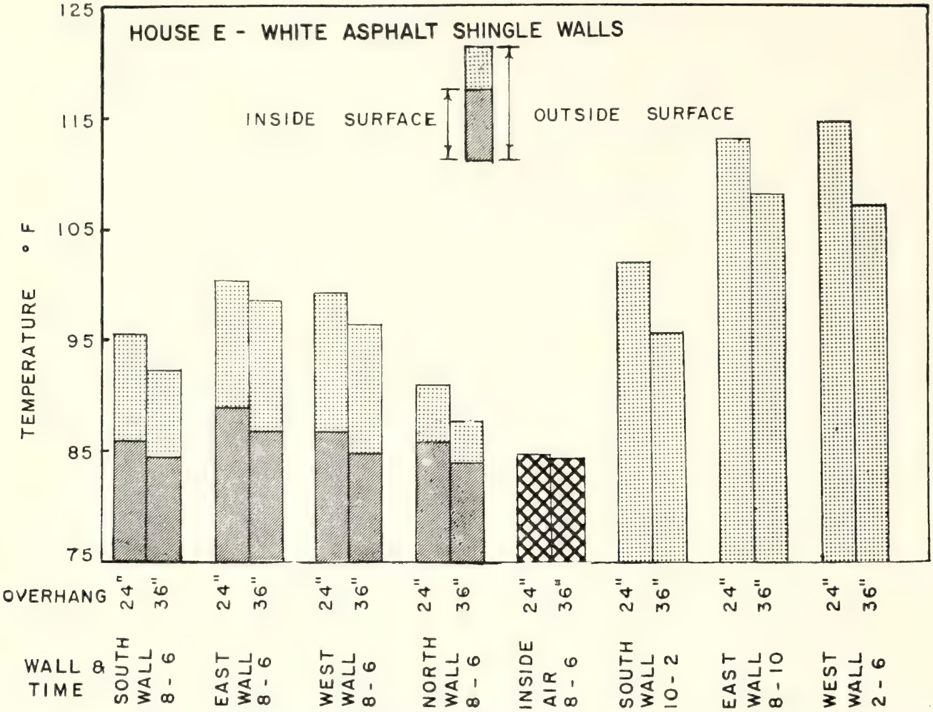


Figure 8. Effect of roof overhang on temperatures of white asphalt shingle wall house.

and 55.3 BTU's/sq. ft. above this point in the shaded portion of the wall.

This small amount of radiation was not true with the east or west walls, as can be seen from table 1, at 8:00 a.m. or 4:00 p.m. At this time the wide overhang did not shade too much more of the wall's surface than the narrow overhang, therefore the large amount of radiation being received by the walls was about the same for all widths of roof overhangs.

Temperature of the outside surface of the west wall was higher than that of the east wall during each wall's critical time period. Temperature of the east wall was high enough to indicate that a large amount of heat could be taken in through the wall if made of a transparent or radiant absorbing material. In the overall daily (8:00 a. m. - 6:00 p. m.) average the east wall showed a higher average temperature than the west wall. This was due to a low morning outside air temperature for the west wall as compared to the high afternoon air temperature for the east wall.

Width of Roof Overhang on Protection from Rain

The protection the roof overhang gives the wall from rain is shown in figure 9. This figure shows the moisture content of the blocks, which gives an indication as to the amount of rain that reached the wall at that particular height. This 36-inch wide overhang did not protect the entire height of the wall from all the rains but it showed better protection than the 12 or 24-inch overhang. The

24-inch overhang gave more protection than the 12-inch overhang but it would not protect the average height window sill or part of the lower sash of the window from all rains.

Different Materials or Color of Materials

The effects of different materials and colors are shown in figures 10 and 11. There is a great differential between the temperature of the outside surface of the walls when different materials or colors are used. This is also true of the inside surface and the inside air temperatures, but the differences are not as great as that of the outside surface. The latter two have the most effect on the comfort inside the room.

Dark color on the outside wall gave a higher inside surface and inside air temperature than white. Some materials used on the outside wall gave a higher inside air and surface temperature than other materials. With the materials and colors tested, the dark-colored asbestos shingle gave the highest temperatures and the brick veneer painted white gave the lowest temperatures for summer conditions.

Color of the outside surface is not the only determining factor for the temperature of the inside wall surface or air. The kind of materials in the wall or the method of construction will also effect these inside

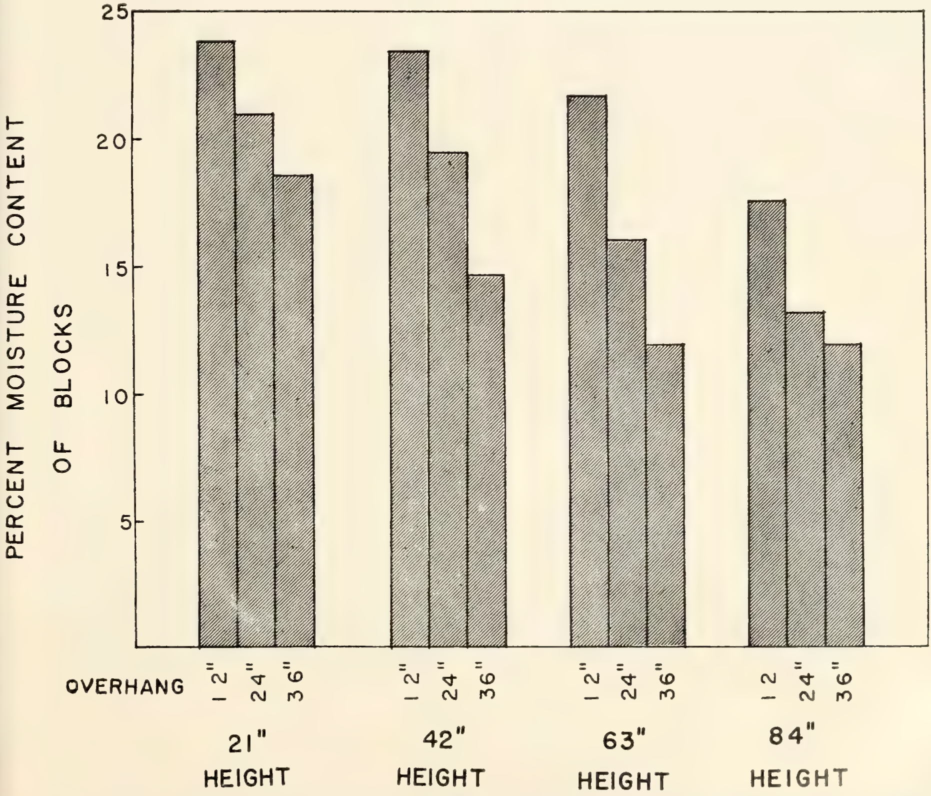


Figure 9. Average moisture content of wood blocks showing the protection that different widths of roof overhang gave the walls. The heights given are above floor level of the house.

temperatures. This can be seen in figures 4 and 7 for house A and D. House D was dark red on the outside whereas house A had a light colored surface but the inside air and wall surface temperature in house D was lower than house A. With the same material and method of construction the darkness of the color of the outside surface did increase the inside wall surface and air temperatures as can be seen by comparing data on houses A and B, C and H, and D and G.

Although the dark color outside surface might make the room more uncomfortable in summer, it will help the heating of the room in

Table 2. Average temperatures (F) for the inside surface of the outside walls and the inside air for a period during the winter in houses A, B, C and H.

House	Outside walls	Side of House				Inside air
		East	South	West	North	
A	white asbestos shingles	64.3	65.3	65.8	59.4	69.5
B	green asbestos shingles	67.2	71.7	66.2	65.1	70.1
C	white concrete block	58	63	57.4	56	68.8
H	green concrete block	62	66.9	58.9	57.7	68.9

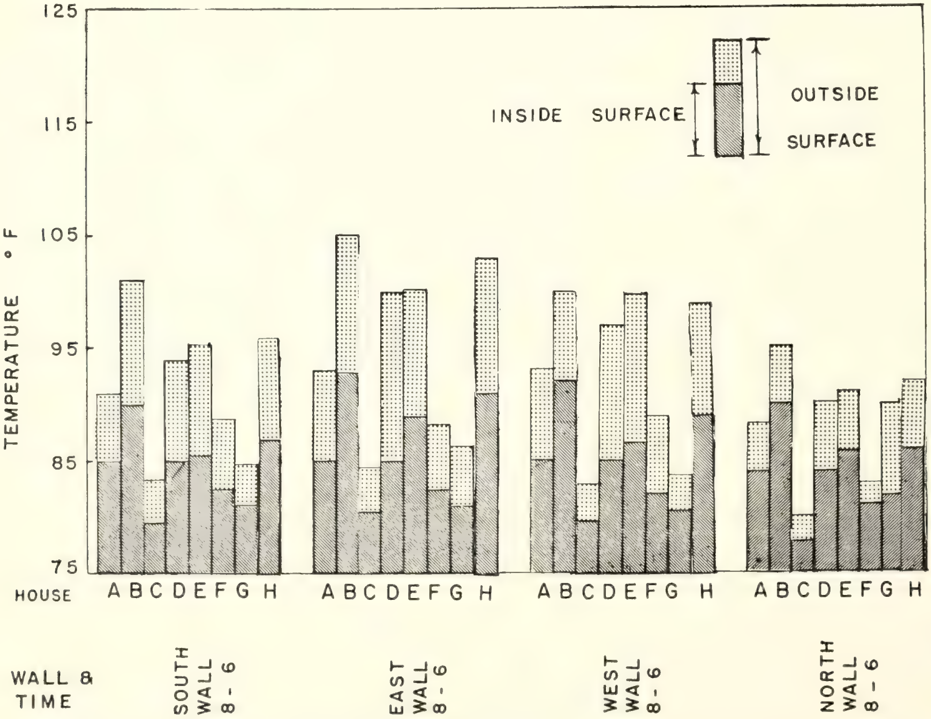


Figure 10. Average temperature for the inside and outside surface of walls on different houses with the same width of roof overhang.

winter. The temperatures of the inside wall surface and air for winter conditions are given in table 2. Houses with dark green outside surface had warmer inside walls than the same wall material when the outside surface was white.

Using the amount of energy to heat house A as 100%, then the requirement of the other houses were: House B 90.8%; House C 173%; House H 154%, and House D 86.7%. These were the only houses tested for heating. House C (white concrete blocks) gave the most comfortable condition in summer but it was the most uncomfortable and required the most heat during winter.

The shielded globe thermocouple temperatures for the inside east and west walls are given for three of the houses in table 3. These readings indicate the amount of radiant heat given off by each of the walls. The higher the temperature the more radiant heat given off by the wall. It will be noticed that the wall with the highest surface temperature gave the highest radiation reading. This would normally be expected, therefore, it is important to keep the inside surface of the walls cool for increased comfort in the summer. This inside surface temperature gives as good an indication of the comfort inside the room as does the inside air temperature.

Window Screening Material Test

Different types of screening materials were used over the windows

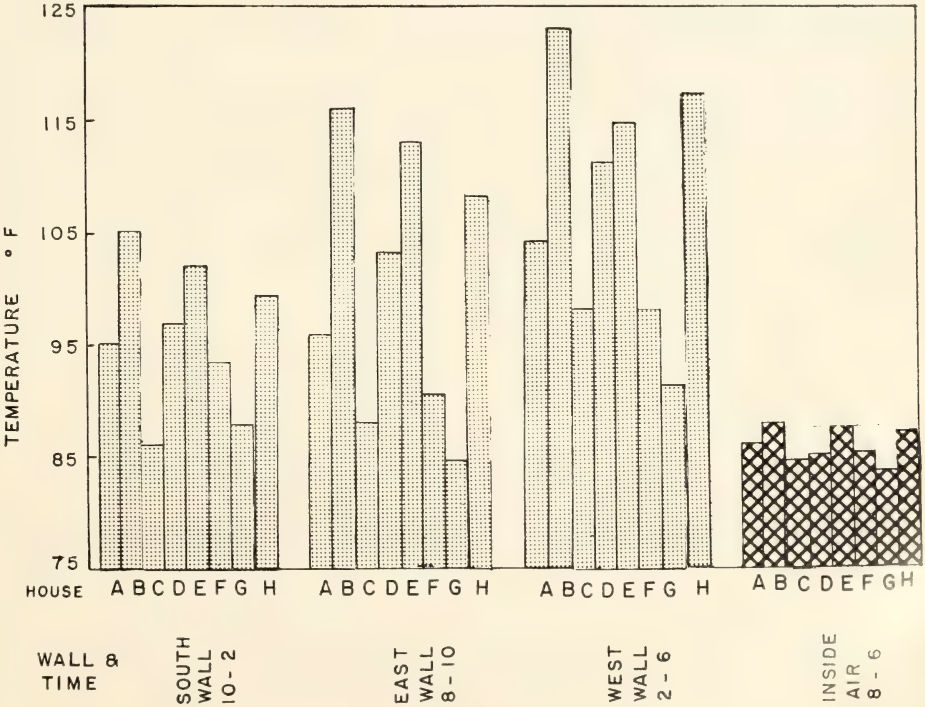
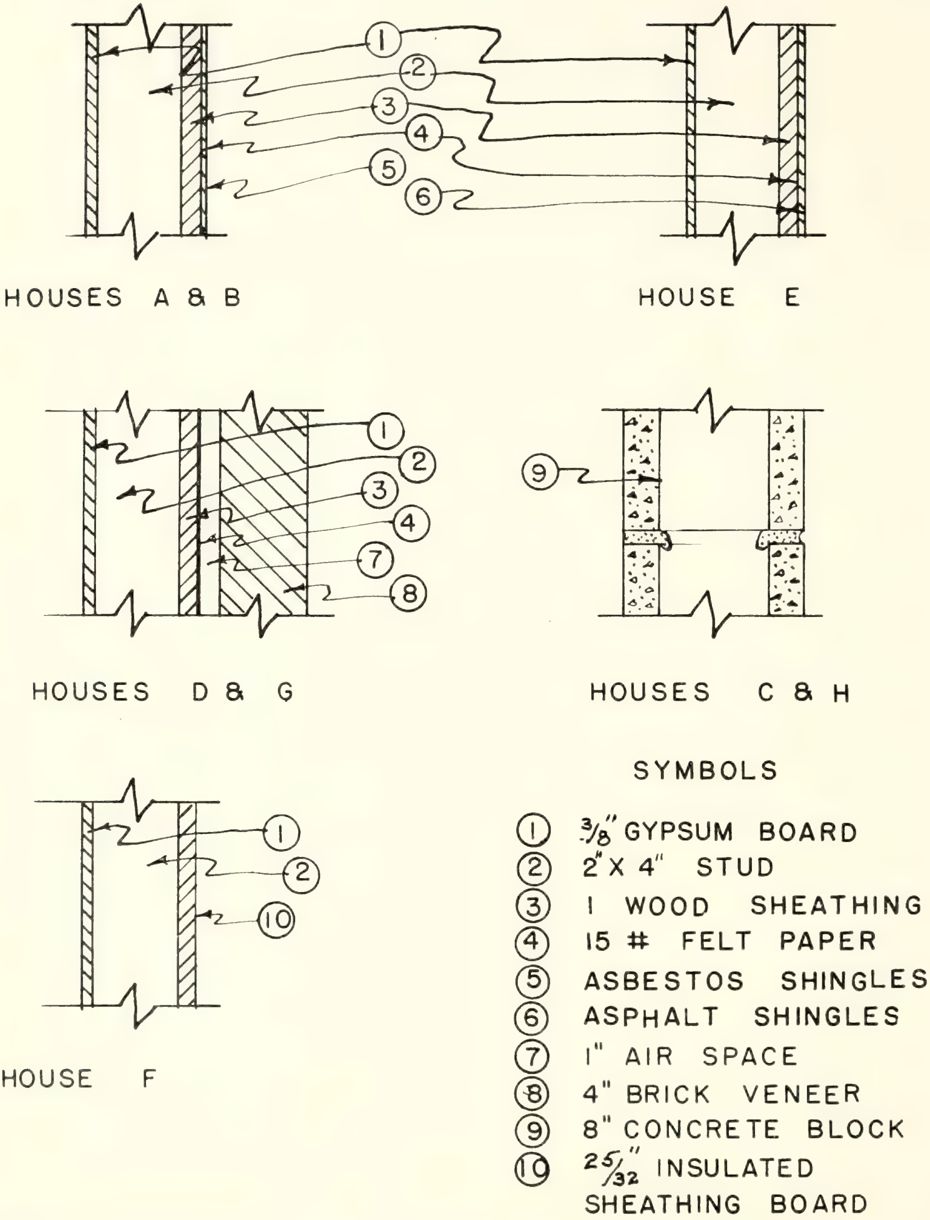


Figure 11. Outside surface critical period temperatures and the inside air temperature for different houses with the same width of roof overhang.


①
②
③
④
⑤
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HOUSES A & B
HOUSE E
①
②
③
④
⑦
⑧
HOUSES D & G
⑨
HOUSES C & H
①
②
⑩
HOUSE F
SYMBOLS
① 3/8" GYPSUM BOARD
② 2" X 4" STUD
③ 1 WOOD SHEATHING
④ 15 # FELT PAPER
⑤ ASBESTOS SHINGLES
⑥ ASPHALT SHINGLES
⑦ 1" AIR SPACE
⑧ 4" BRICK VENEER
⑨ 8" CONCRETE BLOCK
⑩ 25/32" INSULATED SHEATHING BOARD

Figure 12. Cross section of a segment of them all construction for the test houses.

to measure their effectiveness in reducing the amounts of radiant heat, light and air passage. Table 4 shows the results of the test on the heat and light passage. There was no measurable difference in the amount of air allowed to pass through the different materials. The punched louvered aluminum material showed a greater tendency to tear than the woven aluminum or galvanized metal wire, therefore, it would have to be handled with greater care. The life of the materials and their ability to restrict insect passage were not tested.

Table 3. Average shielded globe thermocouple temperatures (F) for the inside surface of the east and west walls of houses A, B and H during the summer.

Wall	House		
	A, white asbestos shingles	B, green asbestos shingles	H, green concrete block
East	86	90	89
West	90½	95	93

Table 4. Amount of radiant heat and light permitted to pass through three different screening materials.

Material	% radiant heat passed	% light passed
Woven aluminum wire	59.8	66.7
Woven galvanized wire	56.4	64.3
Punched louvered aluminum material	16.5	33.3
Punched louvered aluminum material reversed	65.5	66.7

APPENDIX

Appendix Table 1. Average temperatures for walls and inside air of different houses with different widths of roof overhang.

	Over-				House				
Inside surface	hang	A	B	C	D	E	F	G	H
South wall	12"	84.7			85			79.7	
8 am - 6 pm	24"	84.3	90	80.6	84.3	86	82.7	80.6	87
	36"	83.7	89			84.5			
East wall	12"	846.			85.7			80.7	
8 am - 6 pm	24"	82.6	91	81.3	84.7	89	82.5	80.5	89
	36"	82	90			86.8			
West wall	12"	85.2			85.5			81.4	
8 am - 6 pm	24"	84.3	91	81.2	84.5	86.8	82.2	80.8	89
	36"	84.2	89			84.9			
North wall	12"	83.1			84			82	
8 am - 6 pm	24"	82.9	88	79.6	83	85.8	81.2	81.9	86
	36"	81.8	87			83			
Inside air	12"	83.8			82.2			81.4	
8 am - 6 pm	24"	83.2	86	81.5	82	84.7	82.4	81.1	85
	36"	82.7	85			84.5			
Outside surface									
South wall	12"	89.5			92			85.4	
8 am - 6 pm	24"	88	98	83.5	92	95.5	88.8	83.9	93
	36"	87.1	94.5			92.3			
East wall	12"	92.3			101			87.2	
8 am - 6 pm	24"	92	104.5	84.4	99	100.2	88.1	86.3	102
	36"	91	100			98.6			
West wall	12"	82.5			96.5			86.1	
8 am - 6 pm	24"	91.9	99.9	84	95.5	99.3	89	84.8	98
	36"	90.5	99.4			96.2			
North wall	12"	86.3			89			86.3	
8 am - 6 pm	24"	85.5	89.5	80	89	91	83	85.2	90
	36"	85.3	90.3			87.8			
Outside surface "critical period"									
South wall	12"	92.3			98			84.4	
10 am - 2 pm	24"	90.3	105	86	97	102	93.3	83	99
	36"	90.2	101			95.5			
East wall	12"	97.7			107.5			86.6	
8 am - 10 am	24"	92.7	116	83	103	113	90.4	84.6	108
	36"	91.5	116			108			
West wall	12"	99.8			109			90.2	
2 pm - 6 pm	24"	97.2	123	98	111	114.5	98	88.2	122
	36"	95.2	119			107			

Appendix Table 2. Average moisture content of wood blocks placed on walls of the houses at four different heights with the different widths of roof overhang.

Side of House and Height on Wall *	Roof Overhang		
	12"	24"	36"
South - 21" height	23.4	20.6	18.3
South - 42" height	23.3	19.2	12.9
South - 63" height	21.4	15.2	11.7
South - 84" height	16.3	13.1	11.7
East - 21" height	21.7	18.7	18.0
East - 42" height	21.2	17.5	13.0
East - 63" height	20.2	13.9	11.8
East - 84" height	14.6	13.2	11.8
West - 21" height	25.5	21.8	19.2
West - 42" height	24.4	21.2	16.4
West - 63" height	23.2	17.4	11.8
West - 84" height	21.0	12.4	11.8
North - 21" height	25.5	22.5	19.0
North - 42" height	24.9	19.7	16.0
North - 63" height	21.9	17.4	12.0
North - 84" height	18.2	13.5	12.0

* Heights given are above floor level.

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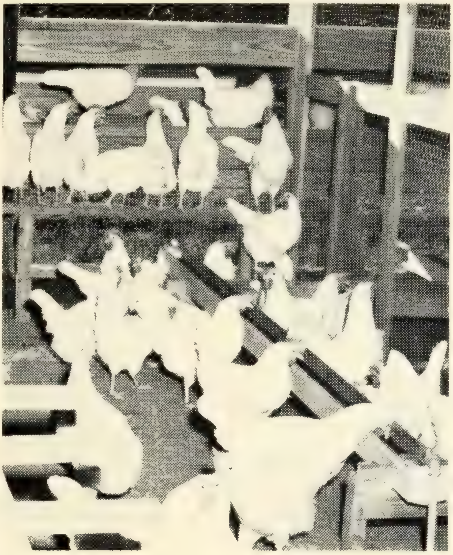


Effects Of Restricted Feeding On The Performance Of Laying Hens

MITCHELL [illegible]
JUN 16 1961

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

Summary

Average mortality from eight weeks to housing was approximately three times greater for the restricted fed groups than the full fed groups, but the average mortality from housing to the end of hte laying period was approximately the same for all groups except Group 2A which was highest. This group was fed 75% ration to 20 weeks of age.

Body weight of the restricted fed groups was considerably lower than the full fed groups at 20 weeks of age; however, the average weight of all groups was approximately the same at 18 months of age.

The average hen-housed egg production was approximately the same for all groups except Group 2A which was lower. Results indicate very conclusively that restricting the feed during the growing period will result in a delay in sexual maturity with a corresponding reduction in the number of small and pewee eggs if the restriction is continued until the birds reach approximately 5% production or if the restriction is extremely high. The increase in profits would possibly be greater to a poultryman who is producing hatching eggs than a poultryman producing commercial eggs because of the increase in price per dozen for medium and large hatching eggs.

The average labor income was approximately the same for all groups, except the group restricted 75% to 20 weeks of age.

Effects of Restricted Feeding on the Performance of Laying Hens

By CHARLES H. THOMAS and R. C. ALBRITTON

Restricting the nutrient intake of pullets during the growing period can be accomplished either by limiting the amount of feed given the birds or by feeding a ration containing a large amount of fiber.

A high fiber ration requires a longer mixing time, has a higher delivery cost, and results in a higher feed consumption than a low fiber ration. These factors may result in an increase in the cost of feed per bird housed even though the actual cost of the feed on a per pound basis is lower than for a conventional or low fiber ration.

When the nutrient intake is restricted by limiting the amount of feed given the birds, these factors are removed; however, the savings in feed costs may be offset by the higher mortality that may result from the limited feed intake.

The research reported was begun in February, 1957 and completed in September, 1960 and was conducted at the Northeast Mississippi Branch Experiment Station. During this period three trials were conducted. In this study the birds were fed a conventional or lower fiber growing mash and oats during the growing period, and restriction was accomplished by limiting the daily amount of feed.

The objectives were to study the effects of restricting the feed during the growing period of Single Comb White Leghorn pullets on mortality, age at sexual maturity, body weight, egg size, egg production, and feed consumption.

Day-old White Leghorn pullets were full fed a starter ration to 8 weeks of age. Then they were weighed and equal numbers were randomly assigned to each of 3 groups in each trial. The restricted feeding program was begun at 9 weeks of age in Trials 1 and 2 and at 8 weeks of age in Trial 3. The pullets were moved to the range at 10 weeks of age in Trial 1, at 9 weeks of age in Trial 2, and at 8 weeks of age in Trial 3.

All groups were fed a growing mash containing 18% protein from 8 weeks of age to housing, and the feeding of oats was begun at 10 weeks of age in Trial 1, 9 weeks of age in Trial 2, and 7 weeks of age in Trial 3. The pullets in Group 1 were full fed, and the pullets in Groups 2 and 3 were fed 75% and 50%, respectively, of the amount Group 1 consumed the previous week (Table 1).

All birds were vaccinated for Newcastle and Bronchitis at 4 days, 4 weeks, and 4 months of age and for Fowlpox at 8 weeks of age.

At 20 weeks of age the birds were weighed and 100 birds were randomly selected from each of the 3 groups and placed in the laying house where they had access to as much laying mash as they would eat. These laying house groups were designated as 1A, 2A, and 3A. The remaining birds in each of the initial groups were designated as Groups 1B, 2B, and 3B and remained on the range until they reached either 5% production or 26 weeks of age at which time 100 pullets from each group were placed in the laying house and full fed laying mash.

All eggs laid by each group were classified daily into the following weight classes: extra large, large, medium, small, and pewee. Egg production for each group was recorded from the first egg until 365 days after 5% production was reached. The birds received approximately 14 hours of light daily in the laying house.

In determining the cost and income the following prices were used: chick cost $0.35, starting mash $4.40 per 100 pounds, growing mash $4.00 per 100 pounds, oats $2.95 per 100 pounds, laying mash $3.61 per 100 pounds, brooding and vaccination $0.04 per bird, extra large and large eggs $0.42 per dozen, medium $0.36 per dozen, small $0.30 per dozen, pewee $.24 per dozen, and old hens $0.10 per pound.

Mortality

The mortality from day-old to eight weeks of age averaged 7.4% for the three trials. The average mortality from eight weeks to housing was approximately three times greater for the restricted fed groups than the full fed groups. (Table 2.) This higher mortality is reflected in the higher cost per bird to housing and in some instances tended to offset the savings from the lower feed cost (Table 3).

The average mortality in the laying house was approximately the same for all groups except the group that was restricted 75% to twenty weeks of age. This group had extremely high mortality in the first trial (49%) and the highest mortality in the second trial (Table 2).

Weight

The average weight of all birds at 8 weeks of age was approximately the same in all 3 trials (1.2 lbs.). The group restricted 75% weighed approximately one-half pound less and the group restaicted 50% weighed approximately one pound less than the full fed group at 20 weeks of age. The average weight of the birds at 18 months of age was approximately the same for all groups (4.2 lbs. to 4.4 lbs.); however, the birds restricted 50% until 26 weeks of age were lighter than either full fed group in every trial at 18 months of age (Table 4.).

Age At First Egg

The birds restricted 75% and housed at 20 weeks of age reached 5% production and 50% production at approximately the same time as the two full fed groups; however, those restricted 50% and housed at 20 weeks of age reached 5% production approximately 15 days later and 50% production approximately 23 days later than the full fed group. The birds that were left on the range until they reached 5% production or 26 weeks of age reached 5% production approximately 14 days (75% full fed group) and 30 days (50% full fed group) later than the full fed group which remained on the range until it reached 5% production (Table 5). In this study the age at sexual maturity was governed not by the amount of restriction but also by the length of time the birds were restricted.

Egg Production

Egg production records are given in Tables 6 and 7. The average percent hen housed production was approximately the same for all groups with the exception of the group that was restricted 75% and housed at 20 weeks of age. The low average production in this group resulted from the results obtained in the first 2 trials. The percent small and pewee eggs was reduced considerably in the groups restricted 50% and in the group restricted 75% until 5% production or 26 weeks of age. Restricting the feed 75% to 20 weeks of age did not result in a reduction in small and pewee eggs.

Since the birds restricted 75% to 20 weeks of age reached sexual maturity at approximately the same age as the full fed birds, a reduction in small and pewee eggs would not necessarily be expected. These results tend to indicate that restricting the feed of the birds should be continued until they begin to lay in order to obtain the greatest reduction in small and pewee eggs.

Cost and Feed-Egg Ratio

The pounds of feed required to produce a dozen eggs were based on feed consumed after the birds reached 5% production. The average pounds of feed consumed per dozen eggs was approximately the same for all groups ranging from a low of 5.50 to a high of 5.82.

For the average of the 3 trials the pounds of feed required per dozen eggs decreased as the egg production for each group increased (Table 8). The cost and labor income per 100 birds housed is given in Table 9.

The group with the highest labor income was different in each trial. The groups restricted 50% to 20 and 26 weeks of age had a higher labor income than either full fed group in Trials 1 and 2; however, in Trial 3 these 2 groups had a lower labor income than either full fed group. The lower labor income in Trial 3 from the 50% restricted groups probably could be accounted for by the fact that mortality was as high or higher in these groups than it was in the full fed groups. This high mortality resulted in considerably lower total income.

The average labor income for the 3 trials was highest for the full fed group housed at 20 weeks of age. The group restricted 75% to 5% production or 26 weeks of age and the groups restricted 50% ranked between the 2 full fed groups in average labor income for the 3 trials. The group restricted 75% to 20 weeks of age had the lowest average labor income although in the third trial the labor income for this group was higher than the labor income from the other restricted groups.

Table 1. Pounds of feed consumed per 100 birds from one day of age to housing (means of 3 trials).

	Group 1		Group 2		Group 3	
Weeks	Mash	Oats	Mash	Oats	Mash	Oats
0- 8	438	5	434	5	442	5
8- 9	88	29	78	25	68	19
9-10	83	30	70	25	57	22
10-11	71	29	50	32	35	22
11-12	82	42	50	23	36	16
12-13	89	44	67	34	47	24
13-14	90	31	73	35	52	25
14-15	78	34	74	27	52	18
15-16	87	30	65	28	47	21
16-17	86	24	72	25	52	18
17-18	89	26	71	20	50	14
18-19	83	34	73	24	52	16
19-20	80	29	70	28	50	21
20-21	91	28	64	24	42	13
21-22	109	30	76	25	52	16
22-23	99	37	97	28	61	16
23-24	101	30	88	36	61	19
24-25	--	-	88	34	61	17
25-26	--		88	15	61	17

Table 2. Percent mortality.

			Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
0-8 weeks	Mean		7.4	7.4	7.4	7.4	7.4	7.4
	Trial	1	8.3	8.3	8.3	8.3	8.3	8.3
		2	7.8	7.8	7.8	7.8	7.8	7.8
		3	6.2	6.2	6.2	6.2	6.2	6.2
8 weeks to housing	Mean		4.4	5.0	13.4	13.7	17.9	19.5
	Trial	1	4.5	4.6	5.7	5.8	14.7	14.7
		2	3.5	5.1	11.4	12.4	10.5	15.3
		3	5.2	5.2	23.0	23.0	28.6	28.6
Housing to end of laying period	Mean		13.0	12.7	26.3	11.0	10.7	15.0
	Trial	1	15.0	15.0	49.0	9.0	11.0	12.0
		2	11.0	13.0	17.0	11.0	7.0	11.0
		3	14.0	10.0	13.0	13.0	14.0	22.0

Table 3. Cost per bird to housing. (Based on number of birds alive at housing).

			Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
Chick cost	Mean		0.40	0.40	0.44	0.45	0.47	0.48
	Trial	1	0.42	0.42	0.42	0.43	0.47	0.47
		2	0.39	0.39	0.43	0.43	0.42	0.43
		3	0.39	0.39	0.48	0.48	0.53	0.53
Feed cost	Mean		0.72	0.90	0.66	0.87	0.57	0.78
	Trial	1	0.71	0.90	0.60	0.81	0.52	0.66
		2	0.76	0.93	0.68	0.88	0.56	0.81
		3	0.68	0.88	0.70	0.92	0.62	0.88
Total cost*	Mean		1.14	1.33	1.13	1.34	1.07	1.29
	Trial	1	1.17	1.36	1.06	1.28	1.03	1.17
		2	1.15	1.32	1.11	1.31	0.98	1.24
		3	1.11	1.31	1.21	1.43	1.20	1.46

*Four cents added per bird for brooding and vaccination.

Table 4. Body weight (pounds).

			Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
8 weeks	Mean		1.2	1.2	1.2	1.2	1.2	1.2
	Trial	1	1.3	1.3	1.3	1.3	1.3	1.3
		2	1.2	1.2	1.2	1.2	1.2	1.2
		3	1.2	1.2	1.2	1.2	1.2	1.2
20 weeks	Mean		3.0	3.0	2.6	2.6	2.1	2.1
	Trial	1	3.0	3.0	2.6	2.6	2.0	2.0
		2	3.2	3.2	2.7	2.7	2.0	2.0
		3	2.8	2.8	2.6	2.6	2.3	2.3
18 months	Mean		4.4	4.3	4.4	4.3	4.3	4.2
	Trial	1	4.9	4.8	4.7	4.8	4.6	4.6
		2	4.4	4.3	4.4	4.1	4.2	4.2
		3	3.9	3.8	4.0	3.9	4.0	3.7

Table 5. Program of full and restricted feeding, age at housing, and age at 5% and 50% production.

			Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
0-8 weeks			Full	Full	Full	Full	Full	Full
8-weeks to housing			Full	Full	75%*	75%*	50%*	50%*
In laying house			Full	Full	Full	Full	Full	Full
Age at housing** (days)	Mean		140	164	140	174	140	182
	Trial	1	140	166	140	182	140	182
		2	140	159	140	162	140	182
		3	140	167	140	177	140	182
Age at 5% Prod. (days)	Mean		158	164	161	178	173	194
	Trial	1	165	166	166	194	177	200
		2	150	159	157	162	176	193
		3	160	167	159	177	165	189
Age at 50% Prod. (days)	Mean		184	185	186	202	207	218
	Trial	1	189	192	194	221	220	225
		2	183	180	188	187	212	215
		3	179	184	176	198	189	214

*Group 2 was fed 75% and Group 3 was fed 50% as much feed as Group 1 consumed the previous week.

**A Groups housed at 20 weeks. B Groups housed at 5% production or 26 weeks of age.

Table 6. Egg production per group to end of laying period (age at 5% production plus 365 days) and number of each size.

		Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
TOTAL	Mean	20388	19887	18337	20349	20092	19910
	Trial 1	17680	17724	14479	19144	18112	18875
	2	21199	20295	19243	21203	21038	21158
	3	22285	21642	21288	20699	21126	19697
Extra Large	Mean	1528	1249	1098	1293	1427	1323
	Trial 1	1358	850	365	1339	533	916
	2	1936	1638	1860	1273	1991	1773
	3	1290	1259	1070	1266	1756	1279
Large	Mean	12444	12176	10680	12689	12680	13540
	Trial 1	10288	10114	7457	11673	10245	11555
	2	12909	12426	11826	13200	14222	15448
	3	14136	13987	12756	13193	13572	13616
Medium	Mean	5057	5321	5261	5633	5206	4712
	Trial 1	5004	5775	5502	5631	6623	6028
	2	5103	5019	4626	5971	4418	3734
	3	5065	5168	5654	5297	4578	4375
Small	Mean	1086	915	1035	636	666	307
	Trial 1	819	773	808	429	593	327
	2	899	895	711	619	343	184
	3	1541	1078	1586	861	1063	409
Pewee	Mean	272	226	263	98	113	29
	Trial 1	211	212	347	72	118	49
	2	352	317	220	140	64	19
	3	253	150	222	82	157	18

Table 7. Percent production hen housed and percent of each size laid to end of laying period.

		Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
TOTAL	Mean	55.86	54.48	50.24	55.75	55.05	54.55
	Trial 1	48.44	48.56	39.67	52.45	49.62	51.71
	2	58.08	55.60	52.72	58.09	57.64	57.97
	3	61.05	59.29	58.32	56.71	57.88	53.96
Extra Large	Mean	7.53	6.23	5.74	6.37	6.90	6.57
	Trial 1	7.68	4.80	2.52	6.99	2.94	4.85
	2	9.13	8.07	9.67	6.00	9.46	8.38
	3	5.79	5.82	5.03	6.11	8.31	6.49
Large	Mean	60.84	60.97	57.63	62.33	62.81	67.79
	Trial 1	58.19	57.06	51.50	60.98	56.57	61.22
	2	60.90	61.23	61.46	62.26	67.60	73.01
	3	63.43	64.63	59.92	63.74	64.25	69.13
Medium	Mean	25.03	27.06	29.53	27.72	26.41	23.93
	Trial 1	28.30	32.58	38.00	29.41	36.57	31.94
	2	24.07	24.73	24.04	28.16	21.00	17.65
	3	22.73	23.88	26.56	25.59	21.67	22.21
Small	Mean	5.26	4.58	5.57	3.11	3.31	1.56
	Trial 1	4.63	4.36	5.58	2.24	3.27	1.73
	2	4.24	4.41	3.69	2.92	1.63	0.87
	2	6.91	4.98	7.45	4.16	5.03	2.08
Pewee	Mean	1.33	1.15	1.53	0.48	0.57	0.15
	Trial 1	1.20	1.20	2.40	0.38	0.65	0.26
	2	1.66	1.56	1.14	0.66	0.31	0.09
	3	1.14	0.69	1.04	0.40	0.74	0.09

Table 8. Laying mash consumed and pounds of feed per dozen eggs (based on feed consumed after 5% production).

		Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
Consumption before 5% production	Mean	454	0	498	111	662	253
	Trial 1	600	0	612	333	771	421
	2	271	0	430	0	601	275
	3	490	0	452	0	615	64
Consumption after 5% production	Mean	9286	9335	8782	9453	9361	9324
	Trial 1	8953	9126	7792	9435	8922	9496
	2	9277	9194	8997	9669	9353	8976
	3	9627	9685	9557	9256	9807	9500
Total consumption	Mean	9739	9335	9280	9564	10023	9577
	Trial 1	9553	9126	8404	9768	9693	9917
	2	9548	9194	9427	9669	9954	9251
	3	10117	9685	10009	9256	10422	9564
Pounds of feed/doz. eggs.	Mean	5.50	5.66	5.82	5.58	5.60	5.63
	Trial 1	6.08	6.18	6.46	5.91	5.91	6.02
	2	5.25	5.44	5.61	5.47	5.33	5.09
	3	5.18	5.37	5.39	5.37	5.57	5.79

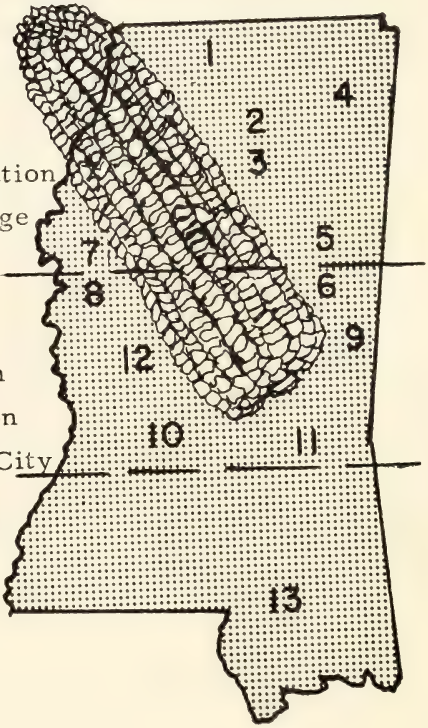
Table 9. Cost and income per 100 birds housed.

		Group 1A	Group 1B	Group 2A	Group 2B	Group 3A	Group 3B
Cost to housing	Mean	$114.33	$133.00	$112.67	$134.00	$107.00	$129.00
	Trial 1	117.00	136.00	106.00	128.00	103.00	117.00
	2	115.00	132.00	111.00	131.00	98.00	124.00
	3	111.00	131.00	121.00	143.00	120.00	146.00
Cost of laying mash	Mean	351.59	336.99	335.00	345.27	361.83	345.74
	Trial 1	344.86	329.45	303.38	352.62	349.92	358.00
	2	344.68	331.90	340.31	349.05	359.34	333.96
	3	365.22	349.63	361.32	334.13	376.23	345.26
Total cost	Mean	465.92	469.99	447.67	479.27	468.83	474.74
	Trial 1	461.86	465.45	409.38	480.62	452.92	475.00
	2	459.68	463.90	451.31	480.05	457.34	457.96
	3	476.22	480.63	482.32	477.14	496.23	491.26
Income from eggs	Mean	673.35	656.89	601.18	676.21	668.83	669.79
	Trial 1	582.42	580.56	465.97	636.52	593.10	626.48
	2	702.18	671.52	689.96	703.96	709.85	719.74
	3	735.44	718.60	697.62	688.14	703.54	663.16
Income from sale of old hens 0.10/lb.	Mean	38.03	37.70	31.32	38.19	38.23	35.48
	Trial 1	41.61	40.94	23.13	44.12	40.80	40.07
	2	39.10	37.78	36.12	36.61	39.32	37.42
	3	33.37	34.38	34.71	33.84	34.57	28.94
Total income	Mean	711.37	694.59	632.50	714.40	707.06	705.27
	Trial 1	624.03	621.50	489.10	680.64	633.90	666.55
	2	741.28	709.30	676.08	740.57	749.17	757.16
	3	768.81	752.98	732.33	721.98	738.11	692.10
Labor income	Mean	245.45	224.60	184.80	235.13	238.23	230.53
	Trial 1	162.17	156.05	79.72	200.02	180.98	191.55
	2	281.60	245.40	224.67	260.52	291.83	299.20
	3	292.59	272.35	250.00	244.84	241.88	200.84

Corn Hybrids and Varieties, 1958 Tests In Mississippi

Locations of 1958 Tests

1	North Miss. Branch Station
2, 3	Pontotoc Branch Station
4	Northeast Miss. Branch Station
5, 6	Central Station, State College
7, 8	Delta Branch Station
9	Black Belt Branch Station
10	Brown Loam Branch Station
11	Coastal Plain Branch Station
12	Schaefer Plantation Yazoo City
13	South Miss. Branch Station



MISSISSIPPI STATE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

JUN 11

RECOMMENDATIONS

Based on the performance of the hybrids in 1958, as well as in past years, the following hybrids are recommended for Mississippi. All have been tested for at least two years.

North Mississippi

White grain: Dixie 55, Dixie 29, Funk G 779W, Pfister (PAG) 653W.

Yellow grain: Pioneer 309B, Dixie 22, Keystone 256, Pfister (PAG) 487.

Central Mississippi

White grain: Coker 911, Coker 811, Dixie 55 (in north), Funk G 785W.

Yellow grain: Dixie 22 (in north), Dixie 18, Dixie 82, Jackson, Funk G 730, Pfister (PAG) 487.

South Mississippi

White grain: Coker 811, Funk G793W, La. 521.

Yellow grain: Dixie 18, Jackson, Lee, Funk G740, McCurdy 1003.

Silage

The best quality corn silage is made from hybrids that produce a high yield of grain. Choose a hybrid in your section recommended for yield and erect plants.

COOPERATIVE PROJECT

These corn tests are a cooperative project between the Mississippi Experiment Station and the Agricultural Research Service, U. S. Department of Agriculture.

Project leader, Robert C. Eckhardt, agronomist, U.S.D.A., State College, Mississippi.

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B. C. Hurt, superintendent, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc.

Louie Walton, superintendent, Black Belt Branch Station, Brooksville.

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E. T. Schaefer, plantation owner, Yazoo City.

1958 CORN HYBRIDS AND VARIETIES

Tests comparing different hybrids were conducted at sixteen different locations in Mississippi in 1958. Three tests were not harvested. The best guide to the desirability of a hybrid is its performance over a period of years at a number of locations.

For the 1958 corn variety tests the state was divided into three sections, North Mississippi, Central Mississippi, and South Mississippi. Holly Springs, Pontotoc, Verona, State College and Stoneville were placed in the northern section; Brooksville, Newton, Raymond, Yazoo City, State College and Stoneville in the central section; Poplarville in the southern section.

Since State College and Stoneville are on the boundary between North and Central Mississippi, two tests were run at each of these locations. One included the hybrids and varieties for North Mississippi and the other those for Central Mississippi. A few are suited to both areas; therefore they appeared in both tests. In some cases there was a difference in yield between the same varieties in these two tests at the same location as can be seen in tables 2 and 4.

Within a section entries were the same. The placing of corn hybrids in one of the sections was done on the recommendation of the breeder. The tests were balanced lattices of 25 entries with six replications.

Each plot was two rows wide and ten hills long except at State College where the plots were two rows wide and five hills long.

With a perfect stand, the plants per acre were 7112 at Brooksville and Poplarville, 11,760 at Stoneville and Verona, 8688 at State College, and 7840 at all other locations. Four or five seeds were planted per hill and thinned to the desired number of plants. The percentage of plants lodged as reported in the tables is based on actual counts. All plants broken below the top ear-bearing node (joint) were classified as stalk broken, while all plants leaning 30 degrees or more as root lodged.

Ears infested with rice weevil were rated on the percent of ears that were infested. The corn earworm damage grade is based on the number of kernels damaged, with the lowest best.

Ear height is reported as the distance in feet from the ground to the point where the top ear is attached to the plant. Husk length is reported as inches beyond the ear tip. Husk tightness is reported as a grade, with a low number loose, a high tight.

Table 1 **Average of North Mississippi Main Hybrid 1958 Tests Grown at Holly Springs, Verona, State College, Pontotoc Ridge, Pontotoc Flatwoods, and Stoneville, respectively.**

Pedigree	1958 Acre yield	3-yr. avg. yield 56-58	Plants erect at harvest	Lodging		Earworm damage[1]		Ear ht.	Ears per plant	Husk[2]		Shelling	Stand
				Root	Stalk					lgth.	Tightness		
	bu.	bu.	%	%	%	rat'g	%	ft.	no.	in.	grade	%	%
Dixie 55	74.3	79.5	95	1	4	.72	77	4.5	1.3	3.2	2.8	84	94
Pioneer 309B	69.6		98	1	1	.92	85	3.6	1.0	1.8	1.5	86	94
Funk G 779W	67.4	71.7	89	3	9	1.40	92	4.2	1.1	.2	.0	84	94
Funk G 710AA	67.1		90	2	8	.86	80	4.2	1.0	1.0	.5	85	95
Dixie 29	67.0	74.7	94	1	5	.80	86	3.9	1.1	1.0	.5	84	95
Dixie 22	66.4	73.9	90	2	8	.81	80	4.7	1.1	2.0	1.8	83	93
Keystone 255	66.1		89	2	9	.89	72	4.4	1.0	1.8	1.8	86	93
Pfister PAG 487	65.5		93	2	5	.80	78	4.5	1.2	3.0	3.0	86	92
Keystone 256	65.4		92	2	6	.60	68	4.4	1.0	2.5	2.5	87	94
Pioneer 309A	63.7	68.9	98	0	2	1.34	92	3.0	1.0	2.0	1.2	87	95
Pfister PAG 653W	63.4	71.7	94	1	5	.71	75	3.9	1.2	1.8	1.2	84	94
Mid-South	61.1		95	1	4	.93	86	4.2	1.0	2.0	1.5	81	96
Early South	60.6		91	4	5	1.46	93	3.8	1.0	1.0	.2	83	94
Tenn. 501	60.6		91	2	7	1.29	94	3.3	1.0	1.2	.5	82	93
Pfister PAG 633W	57.3	68.3	94	1	5	1.34	88	3.5	1.1	1.5	1.2	81	92
Pfister PAG 488	39.1	61.7	91	1	8	3.02	100	3.0	.9	.0	.0	84	92
Miss. 6135*	81.6	80.8	92	1	7	.90	82	4.7	1.6	2.5	2.5	85	97
Miss. 6131*	77.1	81.6	92	2	6	.91	86	4.4	1.4	2.5	2.2	85	95
Miss. 6133*	74.1	77.9	91	3	6	.90	84	4.5	1.4	2.8	2.5	85	96
Dixie 55* cms Rf	73.8		94	1	5	.70	69	4.5	1.2	3.0	2.8	83	96
Miss. 8000*	63.1		98	1	1	.80	82	3.7	1.2	2.8	2.2	82	94
Miss. 8020*	60.6		96	1	3	.95	84	3.9	1.2	1.5	1.0	84	88
Miss. 8008*	59.4		93	1	6	.56	62	4.0	1.2	3.0	2.8	85	91
Miss. 8006*	57.1		94	2	4	.64	72	3.9	1.2	1.8	1.2	84	89

[1] Two-station average.
[2] One-station data.

* Experimental hybrid; no seed available.

Table 2 Average Yield and Plants Erect at Harvest for 6 Locations in North Mississippi, 1958.

Pedigree	Yield in bushels per acre						Avg. North Miss.	Percent plants erect at harvest						Avg. North Miss.
				Pontotoc							Pontotoc			
	Holly Springs	Ver-ona	State Col.	Ridge	Flatw.	Stone-ville		Holly Spr.	Ver-ona	State Col.	Ridge	Flatw.	Stone-ville	
Dixie 55	81.6	59.0	101.1	66.4	45.7	92.2	74.3	95	96	98	93	89	97	95
Pioneer 309B	73.8	58.4	82.6	63.9	39.7	99.4	69.6	100	95	97	98	99	98	98
Funk G 779W	65.8	66.5	79.3	61.0	39.2	92.6	67.4	81	86	99	86	84	93	89
Funk G 710AA	65.6	62.0	82.2	61.6	34.9	96.5	67.1	84	83	94	95	83	97	90
Dixie 29	71.8	51.7	82.8	60.4	43.1	92.0	67.0	95	94	99	95	90	91	94
Dixie 22	73.1	51.4	82.7	58.8	41.5	90.8	66.4	84	89	100	89	82	95	90
Keystone 255	74.4	50.8	80.5	62.4	39.7	88.8	66.1	84	85	99	89	79	94	89
Pfister PAG 487	68.0	53.3	80.2	61.4	34.5	95.5	65.5	90	95	99	93	85	97	93
Keystone 256	68.4	56.4	79.7	58.4	37.4	91.9	65.4	90	92	99	89	84	96	92
Pioneer 309A	64.3	51.4	73.7	61.0	44.7	87.3	63.7	98	97	100	96	97	97	98
Pfister PAG 653W	63.1	45.7	85.2	55.8	35.6	94.7	63.4	93	93	97	95	91	92	94
Mid-South	62.1	45.6	80.4	56.0	32.8	89.9	61.1	88	92	100	95	92	98	95
Early South	65.4	56.2	71.9	50.9	31.5	87.6	60.6	93	86	92	85	92	94	91
Tenn. 501	62.6	50.3	71.9	52.9	42.3	83.9	60.6	96	85	100	90	97	91	91
Pfister PGA 633W	60.3	42.3	74.3	52.4	29.7	84.7	57.3	91	94	97	93	89	96	94
Pfister PAG 488	54.4	37.1	34.1	42.4	26.7	62.4	39.1	96	91	99	91	86	85	91
Miss. 6135*	88.7	53.1	113.8	76.0	46.5	111.5	81.6	91	95	100	91	84	94	92
Miss. 6131*	86.8	55.9	105.1	65.0	43.5	106.2	77.1	94	89	100	92	84	95	92
Miss. 6133*	81.7	51.3	97.2	65.2	38.8	110.2	74.1	94	89	96	88	87	92	91
Dixie 55 cms RF	83.2	55.8	88.3	65.5	45.8	103.9	73.8	94	96	98	91	90	95	94
Miss. 8000*	65.0	49.1	88.9	57.7	28.8	88.9	63.1	99	97	99	98	98	98	98
Miss. 8042	65.3	41.9	87.8	54.4	32.8	88.4	61.8	93	96	96	92	91	90	93
Miss. 8020*	64.8	43.9	84.5	55.8	28.9	85.8	60.6	94	97	98	98	94	97	96
Miss. 8008*	68.7	40.6	80.2	57.2	39.0	70.4	59.4	95	93	97	90	90	93	93
Miss. 8006*	63.9	39.7	82.6	56.7	30.1	69.4	57.1	96	96	97	94	89	96	94

* Experimental hybrid; no seed available.

Table 3 Average of Central Main Hybrid 1958 Tests Grown at Brooksville, Newton, Raymond, Yazoo City, Stoneville, and State College, respectively.

Pedigree	1958 Acre yield	3-yr. avg. yield 56-58	Plants erect at harvest	Lodging		Ears infested			Ear ht.	Ears per plant	Husk[3]		Shell-ing	Mois-ture in grain[4]	Stand
				Root	Stalk	Rice weevil	Earworm[2]				lgth.	Tight-ness			
	bu.	bu.	%	%	%	%	class rat'g	%	ft.	no.	in.	grade	%	%	%
Dixie 18	88.3	69.2	94	4	2	4	.44	59	5.0	1.3	3.3	2.8	85.0	13.5	98
Dixie 55	88.0	87.5	91	5	4	16	.72	77	4.1	1.4	2.8	2.4	83.5	13.4	94
Dixie 82	86.6	76.3	85	8	7	22	.83	81	4.4	1.4	2.7	2.3	81.8	13.5	95
Jackson	84.3		93	5	2	8	.67	71	5.0	1.4	3.2	2.7	84.0	13.6	94
Coker 66	82.4		93	5	2	12	.69	73	4.0	1.5	1.6	1.6	83.7	13.5	97
Funk G 785W	82.0	72.1	86	5	9	20	.75	80	4.1	1.5	1.8	1.8	85.4	13.4	95
Coker 911	81.8	67.4	86	10	4	13	.90	79	3.7	1.2	1.6	1.2	84.7	13.5	96
Funk G 730	81.4		90	5	5	10	.73	73	4.0	1.2	2.4	2.2	85.4	13.5	96
Coker 811	80.3	66.7	95	4	1	3	.44	64	3.8	1.4	2.1	1.8	82.8	13.5	95
Pfister PAG 487	80.0		94	3	3	8	.86	84	4.1	1.3	1.0	1.8	85.5	13.6	97
Funk G 710AA	79.5		88	6	6	38	1.27	83	3.9	1.2	1.4	1.2	84.7	13.4	97
Coker 67	79.0		94	2	4	6	.58	67	3.9	1.5	2.0	2.1	83.0	13.6	95
Funk G 740	77.1		82	4	4	8	.87	79	4.6	1.2	2.0	2.1	83.8	13.5	97
Lee	76.5		97	1	2	4	.49	61	4.4	1.4	3.5	2.8	83.4	13.6	98
Pfister PAG 653W	76.4	71.8	88	6	6	22	.73	79	3.6	1.4	1.9	1.6	84.0	13.4	95
N C 288	76.3		89	5	6	12	.90	84	4.1	1.2	2.7	2.1	81.8	13.5	92
Dixie 22	76.0	70.1	87	4	9	33	.97	86	4.2	1.2	2.0	1.6	82.6	13.4	90
McCurdy 1003C	73.3		84	6	10	10	.70	70	4.1	1.1	2.8	2.4	85.8	13.3	94
Funk G 710	67.2	63.8	87	2	11	12	1.04	78	3.9	1.2	1.6	1.2	83.7	13.5	88
McCurdy 1003	62.4	58.8	89	3	8	10	.73	77	4.2	1.1	2.6	2.1	81.6	13.4	86
Pfister PAG 488	44.6	58.6	83	0	17	56	2.96	100	2.8	1.0	.8	.0	80.8	13.2	92
Miss. 6028*	80.0	71.5	95	2	3	12	.81	84	4.6	1.1	2.5	2.1	82.6	13.6	95
Miss. 6000*	77.7		95	1	4	4	.64	68	4.3	1.1	3.3	2.8	85.0	13.4	97
Miss. 6020*	68.8	65.6	96	2	2	4	.73	75	3.8	1.2	3.5	2.8	83.6	13.6	87
Miss. 6044*	68.6		93	1	6	8	.59	61	3.9	1.2	3.9	2.8	84.2	13.5	83

* Experimental Hybrid: No seed available.

[1] Two-station average.

[2] Three-station average.

[3] Four-station average.

[4] Five-station average.

Table 4 Average Yield and Plants Erect at Harvest for 6 Locations in Central Mississippi, 1958

Pedigree	Yield in bushels per acre						Avg. Central Miss.	Percent plants erect at harvest						Avg. Central Miss.
	Brooks-ville	Newton	Ray-mond	Yazoo City	Stone-ville	State College		Brooks-ville	New-ton	Ray-mond	Yazoo City	Stone-ville	State Col.	
Dixie 18	45.1	74.9	96.5	121.8	102.9	88.4	88.3	99	99	98	68	97	99	94
Dixie 55	45.9	83.1	92.8	115.8	103.0	87.6	88.0	98	97	95	63	96	97	91
Dixie 82	56.5	66.7	85.0	118.0	104.6	88.5	86.6	93	87	88	50	95	97	85
Jackson	45.1	67.8	89.4	123.5	97.1	82.7	84.3	98	97	91	75	96	100	93
Coker 66	42.6	73.4	84.5	111.4	99.5	82.7	82.4	99	100	93	68	98	99	93
Funk G 785W	52.0	62.1	82.5	102.3	104.3	88.9	82.0	96	92	73	64	91	97	86
Coker 911	45.5	64.5	84.0	102.0	97.3	97.2	81.8	98	98	89	31	96	100	86
Funk G 730	49.9	68.8	82.4	105.7	100.7	82.0	81.4	99	98	84	63	97	100	90
Coker 811	36.8	62.5	82.7	111.8	102.4	85.6	80.3	97	100	97	75	98	100	95
Pfister PAG 487	47.4	66.8	84.3	101.4	100.2	79.4	80.0	96	96	78	77	97	100	94
Funk G 710AA	51.0	63.4	76.1	105.3	100.5	80.7	79.5	96	97	84	63	98	88	88
Coker 67	35.6	70.5	87.5	107.8	92.4	80.4	79.0	98	100	88	82	97	100	94
Funk G 740	42.5	67.4	80.9	102.1	92.0	77.5	77.1	97	96	95	70	96	99	82
Lee	35.9	66.8	74.0	109.7	96.6	75.7	76.5	100	99	93	94	99	98	97
Pfister PAG 653W	44.0	73.5	68.1	96.2	90.8	85.8	76.4	94	98	78	63	94	100	88
N C 288	50.0	69.4	70.7	102.9	89.5	75.5	76.3	96	96	88	70	97	87	89
Dixie 22	48.0	71.5	71.3	89.6	93.2	82.2	76.0	94	93	76	66	95	98	87
McCurdy 1003C	47.2	55.1	70.7	93.2	94.3	79.3	73.3	89	95	83	46	90	97	84
Funk G 710	42.4	57.9	59.7	83.8	83.6	76.1	67.2	96	89	72	79	90	97	87
McCurdy 1003	35.5	54.9	60.2	77.4	84.9	61.8	62.4	95	93	81	71	97	96	89
Pfister PAG 488	35.2	45.9	38.5	52.8	61.4	33.5	44.6	98	96	59	61	82	100	83
Miss. 6028*	37.7	65.8	86.0	121.6	91.3	77.6	80.0	100	95	92	86	98	95	95
Miss. 6000*	42.3	65.0	79.2	108.7	92.8	78.4	77.7	100	96	91	92	97	96	95
Miss. 6020*	40.7	53.5	73.1	95.5	80.7	69.0	68.8	100	98	97	86	98	97	96
Miss. 6044*	39.3	54.8	64.9	95.8	78.3	78.7	68.6	94	95	82	91	98	98	93

* Experimental hybrid; no seed available.

Table 5 Southern Main Hybrid Test Grown at Poplarville, Mississippi, 1958

Pedigree	1958 Acre yield	3-yr. avg. yield 56-58	Plants erect at harvest	Lodging		Ears infested			Ear ht.	Ears per plant	Husk		Shelling	Moisture in grain	Stand
				Root	Stalk	Rice weevil	Earworm				lgth.	Tightness			
	bu.	bu.	%	%	%	%	class rat'g	%	ft	no.	in.	grade	%	%	%
Dixie 18	66.4	49.2	89	1	10	40	.28	50	3.4	1.3	2.2	2.2	85.1	11.6	99
Jackson	62.8		93	1	6	38	.70	62	3.7	1.3	2.8	2.7	84.3	11.5	96
Keystone 257	62.6		95	1	4	51	.39	53	3.8	1.2	2.2	2.2	85.4	11.3	92
Funk G 793W	62.3		87	0	13	27	.47	49	3.6	1.1	2.2	2.0	82.6	11.2	98
Coker 66	60.6		89	2	9	71	.70	60	3.3	1.6	2.3	2.2	82.3	11.4	91
Coker 811	60.6	49.0	87	3	10	39	.38	52	3.4	1.5	1.8	1.8	82.2	11.6	95
Lee	60.4		87	0	13	49	.33	39	3.2	1.4	2.0	2.0	83.6	11.3	91
La. 521	59.3	46.5	91	1	8	34	.71	66	3.6	1.3	1.7	1.7	84.9	12.1	99
Pfister PAG 487	58.7		96	0	4	53	.76	64	3.7	1.4	2.0	2.0	84.7	11.7	84
Coker 67	57.8		86	7	7	51	.52	60	3.3	1.6	1.8	1.8	83.1	12.2	91
McCurdy 1003	54.6	42.6	96	0	4	53	.58	59	3.5	1.1	2.6	2.5	82.7	11.1	93
Funk G 740	54.2	42.9	88	2	10	43	.71	66	3.6	1.1	2.2	2.0	83.5	11.4	92
McCurdy 1003C	48.6		90	6	4	53	.47	67	3.6	0.9	2.0	2.0	83.9	10.8	98
McCurdy 1003A	48.1		93	1	6	68	1.12	75	3.5	1.0	2.2	2.0	82.7	10.4	95
Miss. 6042*	69.8		90	3	7	35	.34	45	3.7	1.3	2.0	1.7	84.7	10.9	95
Miss. 6002*	67.0		90	0	10	41	.62	61	3.3	1.3	2.0	2.0	83.5	11.7	98
Miss 8464*	64.6		93	2	5	47	.70	58	3.7	1.5	1.8	1.8	83.2	10.9	93
Miss. 8424*	64.3		97	2	1	61	.70	61	3.8	1.2	1.8	1.8	84.7	11.4	98
Miss. 8428*	63.1		91	2	7	43	.46	54	3.6	1.3	1.8	1.7	84.0	11.1	99
Miss. 8484*	61.4		95	4	1	50	.70	53	3.8	1.3	2.0	1.5	82.2	11.3	97
Miss. 6000*	61.2	50.3	95	0	5	50	.54	51	3.6	1.2	2.2	2.2	85.3	11.5	94
Miss. 8402*	59.9		97	0	3	53	.65	71	3.8	1.2	2.2	2.0	82.9	11.4	97
Miss. 8400*	58.8		92	0	8	55	52	60	3.7	1.2	2.0	2.0	83.0	11.4	95
Miss. 6028*	57.2		93	3	4	68	1.06	83	3.8	1.1	2.8	2.3	82.1	11.3	98
Miss. 8286*	56.5		96	0	4	59	.68	70	3.8	1.1	2.0	1.8	83.8	10.7	97
Average	60.0												83.6	11.36	
L S D	6.7	C V -	9.78												

* Experimental hybrid; no seed available.

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Labor and Technology on Selected Cotton Plantations In the Delta Area of Mississippi

1953-1957

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United States Department of Agriculture

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The writers are indebted to the many plantation operators and workers whose cooperation in providing statistical material made the study possible. They also wish to express their appreciation for the assistance of those who carried on the field interviewing.

Summary and Implications

This report represents the results of one phase of a study of farm labor and technology on large cotton plantations in the Delta Area of Mississippi from 1953 to 1957. During this time, acreage allotments and marketing quotas were reimposed: the Soil Bank Program was enacted into law; and other conservation programs were changed and modified.

The sample for this phase of study includes 40 cotton plantations having cotton allotments of 300 acres or more in 1957. Respondents were selected from the Agricultural Stabilization Committee Work Sheets.

Plantation operators did not enlarge their business through the purchase or renting of additional land. The average plantation size was 1,690 acres in 1953 compared with 1,676 acres in 1957. Nearly three-fourths of the total plantation area was in cropland in both 1953 and 1957.

Cotton was the principal cash crop on the 40 plantations studied. The average number of acres in cotton decreased from 718 in 1953 to 407 in 1957. In 1953. almost three-fifths of the cropland was planted to cotton, but by 1957 only about a third of it was planted to this crop.

In general, plantation operators who were faced with a reduction in acreage of their intensive crop (cotton) did not switch their resources to other intensive enterprises such as poultry, dairy, truck crops, and seed production. The number of plantations with livestock enterprises remained about the same during the 5 years.. However, the plantations with livestock enterprises in 1953 increased the size of these enterprises between 1953 and 1957. Plantation operators are seeking profitable alternative uses for land and other resources diverted from cotton production. Since 1953, a high percentage of cotton land has been diverted to soybeans, wheat, and oats. The proportion of the cropland planted to these three crops increased from 29 percent in 1953 to 48 percent in 1957.

The importance of the wage cotton crop has continued to increase. The number of plantations with 75 percent or more of the cotton acreage in wage cotton increased from 14 to 15 during the 5 years, while the number having 50 to 74 percent of this acreage in wage cotton increased from 4 in 1953 to 9 in 1957. The number having from 25 to 49 percent of the cotton acreage in wage cotton decreased from 7 to 6 during the 5 years, while the number with less than 25 percent of the cotton acreage in wage cotton decreased from 15 in 1953 to 10 in 1957.

Plantation operators increased cotton yields per acre through adoption of new practices and increased efficiency of production. They used more nitrogenous fertilizer, irrigated more, and changed from hand and mule power to machines whenever feasible under the existing level of technological development and economic organization. This change was complicated by the peak demand for hand labor during the chopping and picking seasons and the relatively small demand for unskilled labor during the rest of the year.

The proportion of total cotton (bales) picked by machines increased from 25 percent in 1953 to 45 percent in 1956. Only 8 percent of the cropper cotton was picked by machine in 1953 compared with 45 percent of the wage cotton, while for 1956 the percentages were 25 and 58, respectively. Adverse weather greatly reduced the quantity of cotton picked by machine during the 1957 harvest. It is estimated that 39 percent of the cotton (bales) was machine picked in that year.

Yield of lint per acre was highest on the wage cotton enterprise. The average yield for the wage crop during 1953 was 583 pounds of lint per acre compared with 568 pounds on the cropper acreage. During 1956, yields rose to an average of 667 pounds for the wage crop and 607 pounds for the cropper crop. It dropped to 502 and 492 pounds on the wage and cropper acreage, respectively, in 1957.

Labor requirements were lowered significantly between 1953 and 1957. The reduction in total man-hour requirements on these plantations was due primarily to two factors: (1) The shift from intensive to extensive enterprises and (2) the introduction of new techniques. The shift from intensive to extensive enterprise accounted for an average reduction in labor requirements of roughly 30 percent, while the net effect of the expanded use of new technology resulted in an average reduction in man-hour requirements of 10 to 12 percent.

The number of resident families did not decline in proportion to the reduction in cotton acreage and the increased use of machines because the cotton-production operations that are responsible for peak labor requirements have not been completely mechanized. Also, operators hesitate to depend completely upon seasonal off-farm labor for cotton chopping and picking.

During a "normal" harvesting season, the bulk of the cotton crop could be picked by machines. But in a year with weather resembling that of 1957, a shift must be made from mechanical pickers to picking by hand if the entire acreage is harvested.

The large plantation operator has three potential sources of farm labor for seasonal jobs: Individuals living on the plantations, day-haul workers, and migratory workers. Primary dependence is on resident and day-haul labor. Little migratory labor is employed. The proportion of the wage cotton acreage chopped by resident labor decreased from 75 percent in 1953 to 68 percent in 1957, while the proportion of the hand-picked cotton harvested by resident labor decreased from 78 percent in 1953 to 67 percent in 1957. More plantations hired wage workers from cropper families to chop wage cotton than to pick wage cotton.

In the past the substitution of mechanical equipment for wage and cropper labor has been preceded by increased opportunities in nonfarm employment for the plantation labor force and rising farm wage rate that gave the plantation operators an economic incentive to substitute machines for men. Workers were not displaced by machines. Instead, workers in the productive ages left the area for nonfarm employment and military service. The extent to which machines will be substituted for labor in the future will depend largely upon (1) availability and cost of new and improved machines, (2) prices received by plantation operators for cotton and other crops, (3) wage rates for hand chopping and picking, (4) availability of workers skilled in operation and maintenance of mechanical equipment, (5) opportunities in nonfarm employment, and (6) government agricultural programs.

Labor and Technology on Selected Cotton Plantations in the Delta Area of Mississippi, 1953-1957[1]

By NELSON LeRAY, JR. and GRADY B. CROWE[2]

Labor force adjustments on large cotton plantations in the Delta area of Mississippi have been substantial in recent years. Cotton allotments and mechanization have reduced the need for sharecroppers as well as for the wage laborers. The nature and extent of these adjustments are the subject of this report.

Cotton acreage allotments and marketing quotas were not in effect between 1944 and 1953, except in 1950. Acreage allotments and marketing quotas were reimposed in 1954 and have continued to date. The 1953 Delta cotton crop of 1,065,600 bales, the last crop before allotments were reimposed, was produced on 1,128,500 planted acres. Cotton allotments for the area in 1957 were set at 727,866 acres. About 687,490 acres were in cultivation on July 1, 1957, a reduction of more than 440,000 acres, or 40 percent, from the 1953 crop. From 1953 to 1957, production declined 447,700 bales, or 42 percent. A part of this decline reflects the unfavorable weather in 1957. The 1956 crop was 862,500 bales.

Under the Acreage Reserve of the Soil Bank Program initiated in 1956, farmers could receive payments from the Government for not planting or harvesting part, or all, of their cotton acreage allotment. The 1956 program did not become law until after most of the crop had been planted. During 1957, 55,740 acres of cotton in the Delta area of Mississippi were taken out of production under the Acreage Reserve Program.

The Delta is a major type of farming area in Mississippi[3] and its broad level acreages are well suited to mechanized production practices. In the past, Delta cotton plantations have been largely self-sufficient with respect to labor. The size of the cotton crop was limited primarily by the amount of cotton the resident labor force could pick. Government programs, mechanization, and migration have changed the plantation scene in the Delta.

Tractors have replaced horses and mules. Some laborers have been "pulled" to neighboring towns and northern cities by employment opportunities in industry. Many of the resident field hands have been replaced by mechanical cottonpickers, or by day-haul workers from nearby towns.

This report deals with one phase of a study, the main objectives of which were: (1) Since 1953, to analyze trends in labor requirements on large Delta plantations in relation to technology, participation in Government programs, and changes in crop acreage and production; (2) to determine the present requirements of these cotton farms for workers of various types —croppers, resident wage workers, day-haul workers, and migrants; and (3) to determine the significance of the farm labor force in the area and, in relation to the labor force, to appraise the possibilities for future adjustment. Other reports will deal with the characteristics of the plantation labor force and the day-haul labor force from nearby towns as to residence, age, sex, employment, earnings and migration experiences.

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[1] This report is a part of a larger study of labor in the Mississippi Delta being conducted cooperatively by the Farm Economics Research Division, ARS, and the Division of Sociology and Rural Life of the Mississippi Agricultural Experiment Station.

[2] Agricultural Economists, Farm Economics Research Division, Agricultural Research Service, U. S. Department of Agriculture, stationed at Washington, D. C., and the Delta Branch Experiment Station, Stoneville, Miss., respectively.

[3] For a completed description of the area see Plantation Organization and Operation in the Yazoo-Mississippi Delta Area by Langsford, E. L. and Thibodeaux, B. H., U. S. Department of Agriculture, Tech. Bul. 682, Washington, D. C. 1939.

Method of Study

The data for the study were obtained during March and April, 1958, through personal interviews with farm operators, resident farmworkers, and nonresident farmworkers who lived in selected Delta towns.

This report is an analysis of the interviews conducted with 40 plantation operators. Respondents for these interviews were selected from the Agricultural Stabilization Committee Work Sheets. As the most significant adjustments affecting farm labor have occurred on the larger operations, the universe was restricted to plantations having cotton allotments of 300 acres or more in 1957. Data were obtained on an operating unit basis.

The 1953, 1956, and 1957 Seasons

Growing and harvesting conditions in the Delta vary from year to year, depending primarily on the amount and distribution of rainfall. Cotton production practices must be adapted to weather.

The 1953 growing season was dry and hot. Unusual weather in the spring interfered with planting, and heavy mortality from seedling diseases resulted in poor stands in many areas. Rainfall during the summer was spotted, and many areas suffered from insufficient moisture and high temperatures. Throughout the season, boll weevil infestation was generally light and under control. Rains and wind in late August caused some damage to cotton quality but in general, the harvest season was favorable.

The early growing season in 1956 was more or less "normal" and planting was accomplished without difficulty. May, June, and July were characterized by prolonged droughts and cotton suffered from lack of water. The first 3 weeks of August were unusually hot; maximum daytime temperatures ranged from 95 to 104 degrees. This damaging hot, dry weather was followed by cooler weather, which was beneficial to boll set and development. Boll weevil infestation was early and heavy, but fairly good control was obtained by persistent control programs. The 1956 harvest season was more favorable than usual.

The 1957 production season was characterized by excessive rains throughout. Early rains interfered with land preparation and planting. Planting, which is usually done in April and May, extended well into June. Rains, which continued into summer, intensified the weed and grass problem, provided favorable conditions for insects, and interfered with normal production operations. Plants grew off early but fruited late. Most of the crop was set in August. Early freezing weather, coupled with continued rains, damaged both the yield and quality of cotton drastically.

CHANGES IN PLANTATION ORGANIZATION

From 1953 to 1957, the chief changes made in plantation organization involved a reduction in cotton acreage and a diversion of resources to alternative uses. Shifts were made to other crop and livestock enterprises. The number of cropper families was reduced. Some cotton acreage was put into the Soil Bank Program.

Total Land Use

The average sample plantation contained 1,690 acres in 1953 and 1,676 acres in 1957 (table 1). The most common size of plantation was from 1,000 to 2,000 acres. In 1953 and 1957, this size operation accounted for more than 65 percent of the sample.

Nearly three-fourths of the total plantation area was in cropland in both 1953 and 1957. The proportion of land devoted to permanent pasture increased slightly. Some woodland was cleared and made available for permanent pasture. The proportion of the total plantation area in farmstead, roads, ditches, and wasteland remained unchanged.

Table 1. Land use, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957.

Land use	1953		1956		1957	
	Acres	Percent	Acres	Percent	Acres	Percent
Cropland	1,229	73	1,217	72[1]	1,222[1]	73
Permanent pasture	191	12	213	13	213	13
Woodland pasture	50	3	46	3	47	3
Other woodland	160	9	148	9	142	8
Farmstead, roads, ditches, and waste	54	3	53	3	52	3
Total plantation area	1,690	100	1,677	100	1,676	100

[1] Includes cropland in the Soil Bank Program.

Table 2. Crop organization, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957.

Cropland use[1]	Plantations reporting	Average acreage per plantation reporting	Average acreage, all plantations	Distribution of cropland, all plantations
	Number	Acres	Acres	Percent
		1953		
Crop:				
Cotton	40	718	718	59
Corn	27	99	67	5
Soybeans	33	245	202	16
Oats	30	185	139	11
Wheat	5	183	23	2
Other crops	14	145	51	4
Fallow	11	122	34	3
Total	----	------	[2] 1,234	100
		1956		
Crop:				
Cotton[3]	40	454	454	37
Corn	28	102	71	6
Soybeans	39	330	322	26
Oats	31	220	171	14
Wheat	16	183	73	6
Other crops	22	139	76	6
Fallow	15	172	64	5
Total	----	------	[2] 1,231	100
		1957		
Crop:				
Cotton[3]	40	407	407	32
Corn	28	102	71	6
Soybeans	39	333	325	26
Oats	32	215	172	14
Wheat	24	170	102	8
Other crops	25	130	81	6
Fallow	17	126	53	4
Soil Bank (cotton)	8	217	43	4
Total	----	------	[2] 1,254	100

[1] Annual crops except cotton, on a planted-acreage basis.
[2] Totals do not agree with Table 1 because of double-cropped acreages.
[3] Excludes overplanted acreage that was plowed up to conform with cotton acreage allotment.

Crop Organization

The large cotton plantations studied maintained about the same acreage in crops during the 5 years. A summary of acreages in important crops, the number of plantations reporting each crop, and the average acres in each crop for 1953, 1956, and 1957 are shown in table 2.

Cotton was the chief cash crop throughout the period studied. However, the average number of acres in cotton decreased by 43 percent from 1953 to 1957. In 1953, almost three-fifths (59 percent) of the cropland was planted to cotton, but by 1957, cotton was grown on only about a third of the cropland.

On most plantations, the number of acres planted to cotton in 1957 was the same as the cotton acreage allotment.[4] Thirty-four operators reported no difference between the number of acres planted to cotton and the cotton acreage allotment, while 4 operators reported that they had overplanted and 2 operators said they had underplanted, in 1957. The operators who overplanted plowed up the excess acreage to conform with the allotment. The operators who underplanted reported that they had "guessed and missed" on the planted acreage.

Soybeans ranked second to cotton in acreage grown. They were planted on 16 percent of the cropland in 1953 and by 1957 this acreage had been increased to 26 percent of the cropland.

Although the average number of acres in wheat per plantation reporting this crop decreased during the 5 years under review, the number of plantations whose operators raised wheat increased from 5 in 1953 to 24 in 1957. The number of acres in wheat for the plantations studied increased 4 times from 1953 to 1957.

Corn and oats were other important crops grown in 1953 and 1957. The number of plantations reporting "other crops" increased from 14 in 1953 to 25 in 1957.

Organization of the Cotton Enterprise

As would be expected, the importance of the sharecropper has continued to decline on large cotton plantations in the Delta Area of Mississippi. The relative importance of croppers and wage laborers on the plantations surveyed, expressed in terms of average acreages and the proportion of the cotton acreage handled by each, is given in tables 3 and 4. Share-

Table 3. Organization of cotton enterprise, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957.

Item	Plantations reporting	Average acreage per plantation reporting	Average acreage, all plantations	Distribution of acreage, all plantations
	Number	Acres	Acres	Percent
		1953		
Cotton acreage in				
Cropper cotton	34	471	401	56
Wage cotton	33	384	317	44
Total	--	-----	718	100
		1956		
Cotton allotment in				
Soil Bank[1]	----	------	------	------
Cropper cotton	32	242	193	43
Wage cotton	36	290	261	57
Total	--	----	454	100
		1957		
Cotton allotment in				
Soil Bank	8	216	43	9
Cropper cotton	32	217	174	39
Wage cotton	37	251	233	52
Total	----	------	450	100

[1] The Agricultural Act of 1956 authorizing the Soil Bank did not become law until May 28, 1956.

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[4] On plantations with cotton acreages in the Soil Bank was added to the planted acreage to determine whether the operator underplanted or overplanted.

Table 4. Number of plantations, by percentage of cotton acreage in wage cotton, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957.

Cotton acreage in wage cotton[1] (percent)	1953	1956	1957
	Number	Number	Number
Under 25	15	11	10
25-49	7	5	6
50-74	4	10	9
75 and over	14	14	15
Total	40	40	40

[1] Does not include cotton acreage in the Soil Bank.

Table 5. Livestock organization by type of livestock, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957.

Type of livestock[1]	1953		1956		1957	
	Plantations reporting	Average per plantation reporting	Plantations reporting	Average per plantation reporting	Plantations reporting	Average per plantation reporting
	Number	Number	Number	Number	Number	Number
Workstock[2]	31	22	31	5	30	5
Cattle and calves[3]	26	179	29	237	28	249
Hogs and pigs[3]	5	51	6	78	7	102
Sheep[3]	4	203	3	404	3	404
All plantations	40	-----	40	-----	40	-----

[1] Number on hand January 1.

[2] Includes all workstock on plantation.

[3] Does not include sharecroppers' livestock.

croppers operated an average of 56 percent of the cotton acreage on the plantations in 1953 as compared with 39 percent in 1957. In 1957, however, an average of 9 percent of the cotton allotment acreage was in the Soil Bank Program. If the acreage in the Soil Bank is subtracted from the total cotton acreage, 43 percent of the cotton acreage was operated by sharecroppers in 1957. On these plantations, the importance of the wage crop increased from 1953 through 1957.[5] The shift from cropper to wage cotton shown in table 4 reflects an adjustment to a new type of economic order in the Delta Area of Mississippi.

The number of plantations with all wage or all cropper cotton during 1953, 1956, and 1957 is as follows:

	1953	1956	1957
Cropper cotton only	7	4	3
Wage cotton only	6	8	8

During the period under study, the average acreage of cropper cotton showed a greater decrease than did the average acreage of wage cotton (table 3). The average number of acres in cotton decreased 57 percent, while the average number of acres in wage cotton decreased only 26 percent between 1953 and 1957.

Livestock

From 1953 to 1957 inclusive, the number of cattle and calves, hogs and pigs, and sheep increased on the 40 survey plantations, while, as would be expected, the number of workstock decreased. In 1953, the 31 plantations reported workstock averaged 22 head per plantation (table 5). By 1957, the number of plantations with workstock had fallen to 30, while the average number of head per plantation with workstock had decreased to 5. Mules were used mainly for running water furrows, hauling wood, hauling cotton sacks from the fields, and plowing gardens. Some plantations used horses in connection with beef cattle enterprises.

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[5] The "wage crop" refers to the part of the cotton acreage that is not allotted to sharecroppers but is worked with hired labor or "day hands."

The number of plantations with cattle and calves remained about the same from 1953 through 1957. The average number of head per plantation reporting cattle and calves increased from 179 in 1953 to 249 in 1957, or 39 percent. The size of the hog and pig, and sheep enterprises increased during the 5 years on the comparatively few plantations reporting these livestock enterprises.

Machinery

By 1953, the base year for the study, most of the production operations on the plantations studied, had been mechanized to the extent of the then available machines and techniques. Since 1953, production and harvesting machines have improved. Many of these improved machines have been added to the farm organizations of large cotton plantations in the Delta. The present study makes no attempt at a detailed analysis of farm equipment other than the relationship, if any, between the increasing use of labor-saving devices, Government programs, and the supply and utilization of labor.[6]

Tractors: From 1953 through 1957, plantation operators in the Delta continued to buy more and larger tractors (table 6). The average number of tractors of all types per plantation increased from 11.2 in 1953 to 12.2 in 1957. While some of this increase in tractor numbers was represented by machines suitable to row crop production, most of it was in extra large wheel-type and crawler tractors used for heavy work. The average number of acres of cultivated cropland per row-crop tractor decreased from 110 in 1953 to 99 in 1957.

As was indicated earlier in this report, the substitution of mechanical for animal power had taken place on Delta plantations before the base year of this study. During the period in which tractors increased in both number and size, the cotton acreage was reduced. The average number of acres of cotton per tractor suitable for row work decreased from 66 to 36. That is, in terms of tractor power, operators of the large plantations in the Delta area of Mississippi possessed the tractor power to operate almost twice the amount of cotton acreage in 1957 as was actually operated, assuming that there was no major increase in tractor power requirements per acre between 1953 and 1957.

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[6] See Bibliography of Related Materials for publications that make a detailed analysis of the various types of farm equipment.

Table 6. Number of tractors by specified sizes, survey plantations, Delta area of Mississippi, 1953 and 1957.

Tractors[1]	1953		1957	
	Plantations reporting	Average per plantation report	Plantations reporting	Average per plantation report
Small	9	1.7	9	1.4
Medium	22	3.2	25	2.4
Large	39	8.9	39	9.7
Extra large	6	1.7	19	1.3
Average wheel type	....	11.1	....	11.9
Crawler type:				
Small	2	1.0	2	1.0
Medium	2	1.0	3	1.3
Large	2	1.0	6	1.0
Average crawler type	....	1.0	....	1.2
Average all tractors	....	11.2	....	12.2

[1] In general, small tractors are used with 1-row equipment; medium tractors with 2-row; and large tractors with 4-row equipment. Extra large tractors, usually 4-wheel units, are used primarily for breaking, subsoiling, ditching, and so forth.

Other Machines: A summary of selected items of machinery reported on the 40 plantations studied is given in table 7. From 1953 to 1957 inclusive, the number of mechanical cottonpickers rose from 61 to 74, an increase of 21 percent, while the number of plantations whose operators reported mechanical cottonpickers rose from 28 to 38, an increase of 36 percent. Most of the mechanical cottonpickers were of the 1-row type; however, operators of 8 plantations reported 2-row pickers in 1957, compared with 2 in 1953.

The number and size of other machines on the 40 survey plantation increased during the period under study. The number of plantations with deep tillage equipment increased from 1 in 1953 to 31 in 1957, while the number of plantations with highboys increased from 1 to 25 during this period. By 1957, all plantations studied had shifted to 4-row planters and cultivators. The shift from 2-row planters and cultivators to 4-row machines is particularly significant so far as labor was concerned. In each instance the use of the larger machine reduced the per acre labor requirements for these operators by almost 50 percent. Herbicide applicators were reported on more than half the plantations in 1957, compared with less than a sixth in 1953. Two of the plantations had their own airplanes for spraying and dusting cotton.

There appeared to be no significant relationship between the number and size of the various types of machines and the proportion of the cotton acreage in wage cotton.

Dwelling Units

Between 1953 and 1957, families were moving from the plantations. In the section that follows, an analysis is made of the number of dwelling units located on the survey plantations and the types of families occupying these dwellings. Other sections of this report present information on the role of these families in producing and marketing cotton and other crops. Later reports will show the composition of plantation households, using such measures as age and sex composition, education, work experience, and training.

Table 7. Selected items of machinery by type, on survey plantations, Delta area of Mississippi, 1953 and 1957.

Item[1]	1953 Plantations reporting	1953 Average per plantation reporting	1953 Average all plantations	1957 Plantations reporting	1957 Average per plantation reporting	1957 Average all plantations
	Number	Number	Number	Number	Number	Number
Plantations	40	----	----	40	----	----
Equipment:						
Deep tillage plows or chisels	1	5.0	0.1	31	2.1	1.6
Anhydrous ammonia applicators	34	1.5	1.4	35	1.7	1.5
Herbicide applicators	6	1.2	.2	21	1.4	.7
Planters:	38	----	----	40	----	----
2-row	11	2.8	.8	2	3.5	.2
4-row	35	2.2	2.0	40	2.5	2.5
Flame cultivators	17	2.0	.8	18	1.8	.8
Other cultivators	40	----	----	40	----	----
2-row	24	3.8	2.3	17	1.9	.8
4-row	38	4.8	4.6	40	6.0	6.0
Highboys	1	1.0	[2]	25	1.2	.8
Cottonpickers:	28	----	----	38	----	----
1-row	26	2.2	1.4	33	1.9	1.6
2-row	2	1.5	.1	8	1.4	.3

[1] Does not include mule equipment.

[2] Less than 0.05.

The 40 plantations studied had an average of 35 dwelling units (excluding operator's or manager's dwellings) in 1953 and 29 in 1957 (table 8). That is, from 1953 to 1957 inclusive, an average of 6 dwellings per plantation was torn down, destroyed by fire or wind, or converted to such uses as implement and storage sheds.

Operators of only 8 plantations reported unoccupied dwellings in 1953, but by 1957, the number who reported unoccupied dwellings had increased to 35. Most of the unoccupied dwellings were suitable for year-round occupancy. This fact indicates that, in general, these plantations have housing units that could be used by seasonal migratory agricultural workers.

The average number of occupied dwellings per plantation was 34 in 1953, of which 24 were occupied by croppers and 10 by wage hand families, as compared with 1957 when an average of 23 was occupied, of which 11 were occupied by cropper households and 11 by wage hand families, and 1 was classified as "other."

As will be elaborated upon later, not all resident wage hands were from wage households. Most of the cropper households contained members who worked primarily for wages. Many of the cropper and wage households contained individuals who were employed as mechanics or as other types of overhead workers on the plantations. If any member of a household had a cotton crop, that household was classified as a cropper household.

CHANGES IN COTTON PRODUCTION AND HARVESTING PRACTICES

In addition to major adjustments in land use, machinery, and labor during the 5 years, the 40 large cotton plantations studied made important changes in cotton production practices. Increased applications of nitrogenous fertilizer, irrigation, and changes in pest control, planting, and harvesting methods were the major adjust-

Table 8. Dwelling units; occupied and unoccupied, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957.

Item	1953			1956			1957		
	Plantations reporting	Average per plantation reporting	Average all plantations	Plantations reporting	Average per plantation reporting	Average all plantations	Plantations reporting	Average per plantation reporting	Average all plantations
	Number	Number	Number	Number	Number	Number	Number	Number	Number
Plantations	40	----	----	40	----	----	40	----	----
Occupied dwellings:[1]									
Cropper[2]	34	28	24	32	17	13	32	14	11
Wage households	26	15	10	33	13	11	35	12	11
Other[3]	4	1	[4]	10	2	[4]	10	2	1
Average	----	34	34	----	24	24	----	23	23
Unoccupied:									
Suitable for year-round use	8	4	1	34	7	6	35	7	6
Unsuitable for year-round use	0	0	0	1	4	[4]	2	4	[4]
Average	8	4	1	34	7	6	35	7	6

[1] Does not include operator's or manager's dwelling.

[2] Includes 3 renter households in 1953, 1 in 1956, and 1 in 1957.

[3] Includes foreman, strawboss, mechanic, and nonworker households.

[4] Less than 0.5 dwellings.

Table 9. Cotton fertilization practices, survey plantations, Delta area of Mississippi, 1953, 1956, 1957.

Item	Unit	1953	1956	1957
Cotton planted	Acres	718	454	407
Acreage fertilized	Percent	100	100	100
Nitrogen used per acre planted	Pounds	84	102	109
Percentage of Nitrogen applied as				
Anhydrous ammonia[1]	Percent	76	75	71
Ammonium nitrate	do.	20	19	14
Cyanamide	do.	4	5	4
Uran	do.	0	0	11
Other	do.	0	1	[2]
Total	do.	100	100	100

[1] Proportion of cotton fertilized with anhydrous ammonia is less on smaller cotton farms.

[2] Less than 0.5 percent.

Table 10. Cotton planting methods, survey plantations, Delta area of Mississippi, 1953, 1956, 1957.

Item	Unit	1953	1956	1957
Cotton planted	Acres	718	454	407
Method of planting:[1]				
Solid in drill:				
Plantations reporting	Number	36	34	30
Percentage of acreage				
Hill-dropped:	Percent	90	82	71
Plantations reporting	Number	5	7	15
Percentage of acreage	Percent	10	18	29

[1] Both planting methods used on 1 plantation in 1953 and 1956 and on 5 plantations in 1957.

ments made in these years. In general, these changes were designed to increase production per acre and reduce man-work requirements.

Fertilization

During the 5 years from 1953 to 1957 inclusive, fertilizer used was limited almost exclusively to nitrogenous materials. All of the acreage planted to cotton was fertilized. A summary of nitrogenous fertilizer used is shown in table 9.

Anhydrous ammonia was the most frequently reported source of nitrogen, with ammonium nitrate next in importance. The proportion of nitrogen obtained from anhydrous ammonia decreased from 76 percent in 1953 to 71 percent in 1957, while the proportion of nitrogen obtained from ammonium nitrate decreased from 20 to 14 percent during the same 5-year period. Uran, which was not used as a source of nitrogen in 1953, was reported as the source of 11 percent of the nitrogen used in 1957. Cyanamide was the only other important source of nitrogen.

The most significant change in fertilizer practices during the period under review was not a change in the material used as a source of nitrogen but rather in the number of pounds of nitrogen applied per acre of planted cotton. The total number of pounds of nitrogen per acre of cotton rose from 84 in 1953 to 109 in 1957, an increase of nearly 30 percent. Although weather varied between 1956 and 1957, fertilizer practices did not change materially. The increase from 102 pounds of nitrogen per acre of cotton in 1956 to 109 pounds in 1957 was not due primarily to weather but to the fact that during the last several years, operators have tended to use more nitrogen each year.

Planting

Solid in drill was the most prevalent method of planting cotton on the large cotton plantations studied. However, hill dropping of cotton increased in importance during the 5 years. As indicated in table 10, the proportion of the cotton acreage planted solid in drill decreased from 90 percent in 1953 to 71 percent in 1957, while the proportion hill-dropped increased from 10 to 29 percent during the 5-year period. In 1953, only 5 of the 40 plantations studied reported hill-dropped cotton compared with 15 in 1957. Five plantations used both solid in drill and hill-dropped methods of planting in 1957.

Cross plowing has increased in importance as a weed-control practice in recent years. Effective cross plowing requires a rather heavy stand of drilled cotton. This accounts partly for the fact that drilled planting continues to be the most popular planting method.

Weed Control

Plantation operators in the Delta spend considerable time and money to increase the yield and improve the quality of their cotton through weed-control practices. In addition to the conventional practices of hand-hoeing and using sweep cultivation,

Table 11. Cotton weed-control methods, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957.

Item	Unit	1953	1956	1957
Avergae land in cotton	Acres	718	454	407
Weed control practices used:				
Herbicides:				
Plantations reporting	Number	7	9	15
Applications	do.	1	1	1
Area covered (average)	Acres	176	193	208
Percentage of acreage treated	Percent	28	53	57
Survey plantations:				
Area covered (average)	Acres	31	43	78
Percentage of acreage treated	Percent	4	9	19
Machine cultivation:				
Sweeps only:				
Plantations reporting	Number	40	40	40
Times over	do.	9	10	8
Area covered (average)	Acres	718	454	407
Percentage of acreage covered	Percent	100	100	100
Survey plantations:				
Area covered (average)	Acres	718	454	407
Percentage of acreage covered	Percent	100	100	100
Sweeps and flame:				
Plantations reporting	Number	1	1	1
Times over	do.	3	3	3
Area covered (average)	Acres	50	50	50
Percentage of acreage covered	Percent	8	12	12
Survey plantations:				
Area covered (average)	Acres	1	1	1
Percentage of acreage covered	Percent	[1]	[1]	[1]
Flame only:				
Plantations reporting	Number	4	7	6
Times over	do.	2	2	2
Area covered (average)	Acres	334	228	249
Percentage of acreage covered	Percent	41	43	63
Survey plantations:				
Area covered (average)	Acres	33	40	37
Percentage of acreage covered	Percent	5	9	9
Times chopped (hand-hoed)	Number	3	3	4

[1] Less than 0.5 percent.

two relatively new methods — herbicides and flame cultivation — were used during the 5 years to control weeds on the 40 plantations studied, as given in table 11.

The number of plantations reporting the use of herbicides increased from 7 in 1953 to 15 in 1957. For plantations reporting the use of herbicides, the proportion of the acreage treated increased from 28 percent in 1953 to 57 percent in 1957, while the proportion of the acreage treated for all plantations increased from 4 percent to 19 percent in 1957.

All of the cotton acreage of the large plantations studied was cultivated with machine-mounted sweeps during 1953, 1956, and 1957. In addition to using sweeps only, one plantation reported the use of flame cultivation with sweeps during the survey years, while flame cultivation without sweeps was used on 4, 7, and 6 plantations during 1953, 1956, and 1957, respectively. The proportion of the total cotton acreage flamed increased from 5 percent in 1953 to 9 percent in 1957.

The cotton crop was chopped an average of 4 times in 1957 compared with 3 choppings in 1953 and 1956.

Poisoning

Methods used to control the boll weevil and other insects varied during 1953 to 1957, as given in table 12. The average number of applications of poison per year increased from 10 in 1953 to 12 and 14 in 1956 and 1957, respectively. Most operators used ground machines for early applications and airplanes for late poisoning. The most popular method of poisoning in 1953 was to spray with ground machine and dust with plane, but by 1957, most

Table 12. Cotton poisoning methods, survey plantations, Delta area of Mississippi, 1953, 1956, 1957.

Item	1953	1956	1957
	Acres	Acres	Acres
Cotton planted	718	454	407
	Percent	Percent	Percent
Percentage of cotton acreage poisoned	100	100	100
Poison applications made by	Number	Number	Number
Ground machine	5	6	6
Plane	5	6	8
Total	10	12	14
Plantation operators applying poison by			
Ground machine only:			
Spray and dust	0	0	1
Spray only	1	3	1
Dust only	0	0	0
Total	1	3	2
Ground machine and plane:			
Spray with ground machine, dust with plane	17	6	7
Spray with ground machine, spray and dust with plane	1	6	4
Spray and dust with ground machine, spray with plane	0	0	1
Dust with ground machine, spray with plane	0	0	0
Spray only	4	24	23
Dust only	13	0	0
Total	35	36	35
Plane only:			
Spray and dust	0	0	0
Spray only	0	0	3
Dust only	4	1	0
Total	4	1	3
All plantations	40	40	40

of the operators were using sprays in both ground machines and planes.

Irrigation

Irrigation of cotton on large plantations in the Delta is relatively new. Irrigation data for cropper and wage cotton are presented in table 13. No cotton was reported under irrigation in 1953 but by 1957, 22 percent of the cotton acreage was irrigated. Only 15 percent of the cropper cotton was irrigated compared with 27 percent of the wage cotton. On plantations with irrigated cotton, more than half of the cotton was under irrigation. Seventeen plantations irrigated cotton in 1957 and 1958. However, 2 plantations with irrigation systems in 1957 did not find it necessary to irrigate in 1958 because of the weather during the year. Two plantations added irrigation systems in 1958.

Furrow, sprinkler, and flood systems of irrigation were reported in use. A number of plantations used both furrow and sprinkler systems.

Harvesting

In the opinion of many persons, harvesting cotton by hand is the most tedious and time-consuming operation in cotton production. With the advent of World War II and the accompanying reduction in the farm labor supply and relatively high farm wage rates, the demand for an efficient mechanical cottonpicker increased. However, it was not until 1943 that mechanical pickers were available on a commercial scale. The increase in the number and size of mechanical cottonpickers was noted earlier. The status of harvesting practices is presented in table 14.

From 1953 to 1957, the proportion of wage and cropper cotton picked by hand decreased. The proportion of wage cotton picked by machine showed a greater in-

Table 13. Cotton irrigation practices, survey plantations, Delta area of Mississippi, 1953, 1956, 1957.

Item	Unit	1953			1956			1957		
		Wage	Cropper	Total	Wage	Cropper	Total	Wage	Cropper	Total
All plantations[1]	No.	33	34	40	36	32	40	37	32	40
Average land in cotton	Acres	317	401	718	261	193	454	233	174	407
Percentage of cotton irrigated	Pct.	0	0	0	27	13	21	27	15	22
Total cotton land irrigated	Acres	0	0	0	70	25	95	63	26	89
Cotton irrigation on plantations:										
Plantations reporting	No.	0	0	0	15	5	17	14	7	17
Total land irrigated per plantation reporting	Acres	0	0	0	186	195	222	176	149	206
Percentage of cotton acreage irrigated	Pct.	0	0	0	61	72	53	72	52	54
Plantations reporting by types of irrigation systems:										
Furrow system	No.	0	0	0	5	1	6	4	1	5
Sprinkler system	do.	0	0	0	5	2	6	5	2	6
Furrow and sprinkler systems	do.	0	0	0	4	2	4	4	3	4
Flood system	do.	0	0	0	1	0	1	1	1	2
Total	do.	0	0	0	15	5	17	14	7	17

[1] In analyzing this table, it should be remembered that many plantations had both cropper and wage cotton.

Table 14. Cotton harvesting methods, survey plantations, Delta area of Mississippi 1953, 1956, 1957.

Item	Unit	1953			1956			1957		
		Wage	Cropper	Total	Wage	Cropper	Total	Wage	Cropper	Total
Plantations[1]	No.	33	34	40	36	32	40	37	32	40
Average land harvested:										
Per plantation reporting	Acres	384	471	718	290	242	454	251	217	407
All plantations	do.	317	401	718	261	193	454	233	174	407
Cotton lint per acre Cotton harvesting practice of—	Lbs.	583	568	575	667	607	641	502	492	498
Defoliation:										
Plantations reporting	No.	12	6	14	28	13	31	34	14	36
Land defoliated per plantation reporting	Acres	378	416	503	260	191	315	217	191	278
Percentage of cotton acreage defoliated, all plantations	Pct.	36	16	25	70	32	54	77	41	62
Percentage of cotton (harvested in bales)										
Hand-picked	do.	55	92	75	42	75	55	49	79	61
Machine-picked	do.	45	8	25	58	25	45	51	21	39
Plantations reporting—										
With mechanical pickers	No.	23	24	28	[2]	[2]	[2]	35	30	38
Using mechanical pickers	do.	21	10	26	33	17	37	34	11	37
With mechanical pickers but not using them	do.	2	14	2	[2]	[2]	[2]	1	19	1

[1] In analyzing this table, it should be remembered that many plantations had both cropper and wage cotton.

[2] Data not available.

crease than did the proportion of cropper cotton. A comparison of harvesting data for 1953 and 1957 does not present an accurate picture of changes in cotton harvesting practices on large plantations in the Delta area of Mississippi because of unfavorable weather during the 1957 harvest season, which resulted in grassy conditions, wet ground, a late "top crop," rotting of bolls, and germination of seed in the boll. Because of these reasons, 1956 will be used as the main basis of comparison.

The proportion of all cotton picked by machine (bales) increased from 25 percent in 1953 to 45 percent in 1956. Only 8 percent of the cropper cotton was picked by machine in 1953 compared with 45 percent of the wage cotton, while for 1956 the percentages were 25 and 58, respectively. The average number of acres of cotton per mechanical picker for plantations whose operators reported this type of equipment decreased from 348 in 1953 to 209 in 1957, while for plantations the average number of acres of cotton per mechanical picker decreased from 470 to 220 during the 5 years under review.

The presence of mechanical cottonpickers is not as important as the use to which the pickers are put and the extent to which they are used. A comparison of the number of operators who have mechanical cottonpickers with the number who used mechanical pickers indicates that a few operators do not use their mechanical pickers each year. Cottonpickers were reported on 28 plantations in 1953 and on 38 plantations in 1957; however, only 26 operators used their pickers in 1953 compared with 37 in 1957. During 1953, 2 operators with wage cotton did not use their machines to help harvest the wage crop. This compares with only 1 operator in 1957. But in 1953 14 of the 24 operators with cropper cotton did not use their mechanical pickers to harvest cropper cotton, in 1957, 19 of the 30 operators with cropper cotton did not harvest it with their machines.

Mechanical harvesting has become popular with the operators of large plantations. It means less dependence on hand labor and the availability of mechanical pickers adds stability to hand-picking rates. Operators do not use their machines to the fullest extent possible for several reasons: (1) Many of the resident laborers would be idle if no hand picking were avaliable; (2) the resident laborers want to pick some cotton by hand; (3) skilled picker operators and mechanics are not always available; (4) weather sometimes prohibits picking with machines; and (5) hand-picked cotton grades higher than machine-picked cotton.

Yield of lint per acre was highest on the wage cotton enterprises. In 1953, 1956 and 1957, the largest average yield—667 pounds—was obtained on the 1956 wage cotton enterprise. The lowest yield —492 pounds—was obtained for the cropper enterprise in 1957. Average pounds of lint per acre increased from 575 in 1953 to 641 in 1956, an increase of 11 percent, but dropped to 498 in 1957, a decrease of 13 percent for the 5 years and 22 percent compared production for 1956.

During a "normal" harvest season, the bulk of the cotton crop could be picked largely by machines. However, in a year with weather resembling that of 1957, a shift must be made from mechanical pickers to picking by hand if large portions of the planted acreage are to be harvested or "salvaged."

The use of defoliants to rid the stalks of leaves and thus provide the plant with more aeration and sunlight in order to facilitate both hand and machine picking of cotton increased from 1953 to 1957. The number of plantations using defoliants increased from 14 in 1953 to 36 in 1957, while the proportion of the total cotton acreage defoliated increased from 25 percent in 1953 to 62 percent in 1957.

Labor Requirements

Labor requirements on large cotton plantations in the Delta area of Mississippi were lowered significantly during the period under study. The reduction in total man-hour requirements on these plantations was due mainly to two factors: (1) the shift from intensive to extensive enterprises, and (2) the introduction of new techniques.

As was pointed out earlier in this report, by 1957, cotton allotments and the Soil Bank Program had reduced the acreage of cotton 40 percent below 1953 plantings. Farmers who were searching for alternative crops to plant on the acreage coming out of cotton shifted primarily to soybeans, oats, and wheat—crops that have been produced under highly mechanized conditions for some time. These crops have considerably lower labor requirements than cotton and, for the plantations covered here, this shift accounted for an average reduction in labor requirements of roughly 30 percent.[7] Reductions in numbers of workstock were just about enough to offset increases in numbers of other livestock, so that man-hour requirements for livestock changed very little.

The use of new techniques and the expanded use of other modern technology also acted to influence labor requirements on Delta plantations for the period under study. Some of these techniques, such as deep tillage and supplemental irrigation, while lowering unit labor requirements, actually increased labor requirements per acre. Others, such as shifting to higher multiple-row equipment and increased mechanical harvesting of cotton, lowered both per unit and per acre labor requirements. The net effect of the expanded use of new technology on the 40 plantations studied resulted in an average reduction in man-hour requirements over the 5-year period of 10 to 12 percent. As would be expected, most of this reduction was due to the increased use of mechanical cottonpickers.

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[7] As the most significant adjustments affecting farm labor have occurred on the larger operations, changes for the whole Delta area might not be as pronounced as those found on the sample plantations.

When the reduction in labor requirements resulting from changes in enterprises is combined with the reduction resulting from changes in technology, the total decrease in labor requirements per plantation from 1953 to 1957 inclusive is about 40 percent.

It should be pointed out, however, that a 40 percent reduction in labor requirements on a farm does not mean that 40 percent fewer workers are needed. There is no direct correlation between reductions in labor requirements and reductions in numbers in the labor force. As it is now used on Delta farms, labor is not a highly divisible production resource. It cannot be bought like fertilizer, used when needed, and stored. Because of the peculiar nature of agriculture, some reductions in labor requirements have little effect on the number of workers needed but rather on the length of time for which they are needed. Because of this, the reductions in labor requirements mentioned above will create some real problems in the efficiency with which labor is used.

There are both economic and noneconomic reasons why the resident labor force did not decline in proportion to the reduction in labor requirements. The primary economic reasons are: (1) Those cotton production operations with peak labor requirements have not been completely mechanized; and (2) plantation operators hesitate to depend on seasonal off-farm labor for picking and chopping cotton. Noneconomic reasons for maintaining excess labor vary but, in general, they are related to paternalistic attitudes that have developed betwen plantation operators and resident croppers and day hands on the plantations. Many individuals and their families have long histories of service on Delta plantations. Plantation operators do not displace these individuals with machines; instead, they are replaced by machines through a process of attrition.

CHANGES IN EMPLOYMENT AND MANAGEMENT PRACTICES

Since the introduction of the tractor, the plantation system has undergone a reorganization as complete as the one experienced after the Civil War; but the plantations retain their main employment and management characteristics — close supervision of labor and specialization in production. During early colonial times, the plantation operators depended upon free and indentured labor. This labor was displaced by Negro slaves. The next major change was a shift from slave to cropper labor.[8] Sharecropping began soon after the Civil War and persisted relatively unchanged until the advent of mechanization. The change from cropper to wage labor and the shift whereby the cropper is given only a small acreage of cropland and the operator performs many of the production and harvesting operations for the cropper and charges the expenses against the cropper's share of the crop, or reduces the proportion of the crop received by the cropper, was accelerated by World War II. It continued at about the same level during the 5-year period 1953-57.

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[8] The first shift after the Civil War was to wage labor, but in most areas it was soon replaced by various forms of tenancy. See T. J Woofter, Jr., **Landlord and Tenant on the Cotton Plantation,** Works Progress Administration Research Monograph V, Washington, 1936. p. 9.

Under the old system of sharecropping, the plantation operator furnished the land, dwelling, fuel, tools, workstock, feed for workstock, seed, and half of the fertilizer, poison and ginning, while the cropper furnished the other half of the fertilizer, poison and ginning and all of the labor. Landlord and cropper each received half the crop. There were many modifications of these arrangements, but this was the usual arrangement.

Previous sections of this report have noted that croppers operated 43 percent of the harvested cotton acreage in 1957, compared with 56 percent in 1953; that the number and size of tractors have increased; that increased use has been made of labor-saving equipment and practices; and that the average number of occupied dwelling units per plantation has decreased. Specific employment and management practices are discussed in this section.

Tenure Arrangements

The 32 large cotton plantations in the Delta area of Mississippi that reported cropper cotton in 1953 and 1957 showed little change in the landlord's share of expenses for materials used on the crop and in the share of the crop going to the landlord and tenant from 1953 to 1957 inclusive. Information about tenure arrangements is shown in table 15. The most prevalent arrangement (15 plantations) was the one in which the landlord received 50 percent of the crop and paid for all of the seed and half of the fertilizer, poison, and ginning. The next most prevalent arrangement (14 plantations) resembled the first, except that the cropper paid for half of the seed. When cropper cotton was irrigated or defoliated, the out-of-pocket expenses for these operations were shared equally by the landowner and the cropper.

The operations performed by the plantations for the croppers remained about the same during the 5 years. In general, the plantation operator prepared the land, planted the seed, machine-cultivated, fertilized, and poisoned the cropper's cotton. In addition, when cropper cotton was irri-

Table 15. Cropper tenure arrangement, survey plantations, Delta area of Mississippi, 1953, 1956, 1957.

Item	1953	1956	1957
Plantation reporting:			
	Number	Number	Number
Cropper cotton	34	32	32
Landlord's share of receipts and expenses			
Crop receipts:			
25 percent	1	1	1
50 percent	[1] 32	30	30
60 percent	1	1	1
Seed expenses:			
0 percent	2	2	2
50 percent	14	14	14
100 percent	[1] 18	16	16
Fertilizer expenses:			
25 percent	1	1	1
50 percent	[1] 33	31	31
Poison expenses:			
25 percent	1	1	1
50 percent	[1] 33	31	31
Ginning expenses:			
0 percent	1	1	1
50 percent	[1] 32	30	30
100 percent	1	1	1

[1] Includes 2 plantations with no croppers in 1956 or 1957.

gated, defoliated, or machine-picked, these operations were performed for the cropper by the landlord. This arrangement left the cropper responsible for chopping his crop and hand-picking the part not picked by machine. When not working in their own crops, many cropper did farm wage work. A few did nonfarm work. An analysis of the amount and location of farm and nonfarm wage work done by croppers will be made in the report on the characteristics of the plantation labor force.

Resident Labor

The importance of the resident labor force in picking and chopping wage cotton decreased during the 5 years, table 16. The proportion of the wage cotton acreage chopped by resident labor decreased from 75 percent in 1953 to 68 percent in 1957, while the proportion of the hand-picked wage cotton harvested by resident labor decreased from 78 percent in 1953 to 68 percent in 1957.[9]

More plantations hired wage workers from cropper families to chop wage cotton than to pick wage cotton. Only 21 of the 33 plantations with wage cotton in 1953 employed members of cropper families to hand-pick cotton compared with 26 plantations where members of cropper families chopped wage cotton. In 1957, of the 37 plantations with wage cotton, 23 employed members of cropper families for picking wage cotton, while 29 employed them for chopping.

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[9] See pp. 12-19 for a discussion of harvesting practices.

Table 16. Resident labor use survey plantations, Delta area of Mississippi. 1953, 1956, and 1957.

Item	Unit	1953	1956	1957
Plantations with:				
Cropper cotton	Number	34	32	32
Wage cotton	do.	33	36	37
Resident wage families[1]	do.	26	33	35
Acreages of cropper cotton per plantation	Acre	471	242	217
Acreages of wage cotton per plantation	do.	384	290	251
Resident families per plantation:				
Cropper	Number	28	17	14
Wage	do.	15	13	12
Acreages of cotton per resident family:				
Cropper	Acre	16.8	14.2	15.5
Wage	do.	25.6	22.3	20.9
Wage cotton:				
Plantations where croppers chopped wage cotton	Number	26	27	29
Workers from cropper families per plantation reporting that chopped wage cotton	do.	76	42	39
Plantations where resident wage families chopped wage cotton	do.	26	32	34
Resident wage workers per plantation reporting that chopped wage cotton	do.	42	36	33
Plantations where croppers picked wage cotton	do.	21	20	23
Workers from cropper families per plantation reporting that picked wage cotton	do.	88	43	42
Plantations where resident wage families picked wage cotton	do.	26	27	30
Resident wage workers per plantation reporting that picked wage cotton	do.	45	38	34
Percentage of wage cotton acreages chopped by resident labor (in acres)	Percent	75	68	68
Percentage of hand-picked cotton harvested by resident labor (in bales)	do.	78	78	67

[1] Seven plantations in 1953, 3 in 1956, and 2 in 1957 had wage cotton but no wage families. The wage cotton was tended by nonresident wage workers and by croppers.

The number of plantations with wage cotton but no wage families decreased from 7 in 1953 to 2 in 1957. On these plantations, the wage cotton was tended by nonresident wage workers and by share croppers.

As it is still necessary to chop cotton by hand and to use some hand labor in picking cotton, many plantation operators have hestitated to rely completely on either resident, day-haul, or migratory laborers. Plantation operators believe that the risk is too great to depend almost entirely on seasonal off-farm labor, supplemented by a small resident wage labor force, for chopping and picking. Therefore, it is the practice to assign a small crop to resident families and to employ some members of these "sharecropper" families as wage hands. In addition, some operators assign acreages to families with tractor drivers and other skilled workers as insurance against these hard-to-replace workers leaving during times of peak labor demand.

Nonresident Labor

The number of plantations whose operators reported nonresident laborers remained at 27 during the 5 years, table 17. However, the number on which nonresident labor was employed for cotton chopping increased from 17 in 1953 to 21 in 1957, while for picking the number dropped from 23 in 1953 to 22 in 1957.

Day-haul workers were the major source of nonresident labor. No in-State migrants were reported. One plantation employed out-of-State migrants for cotton chopping in 1953 and 1957, while two plantations utilized this type of labor for hand-picking cotton in 1953. No out-of-State migrants were reported as picking cotton in 1957.

For the plantations whose operators used day-haul workers to chop cotton, the average peak number of workers dropped from 84 to 78 during the period under review, while the usual daily average for the season dropped from 54 to 48. The average peak number of day-haul workers

Table 17. Nonresident labor force, survey plantations, Delta area of Mississippi, 1953, 1956, and 1957

Item	1953		1956		1957	
	Peak	Usual	Peak	Usual	Peak	Usual
	No.	No.	No.	No.	No.	No.
Plantations reporting nonresident labor	27	27	27	27	27	27
Average cotton acreages:	Acres	Acres	Acres	Acres	Acres	Acres
Per plantations reporting	734	734	400	400	406	406
All plantations	718	718	454	454	407	407
Source of labor for:	No.	No.	No.	No.	No.	No.
Cotton chopping:						
Dayhaul:						
Plantations reporting	17	17	21	21	20	20
Average workers	84	54	60	36	78	48
Out-of-State migrants:						
Plantations reporting	1	1	0	0	1	1
Average workers	6	6	0	0	40	20
Total cotton chopping:						
Plantations reporting	17	17	21	21	21	21
Average workers	84	54	61	38	76	47
Cotton picking:						
Dayhaul:						
Plantations reporting	22	22	20	20	22	22
Average workers	91	62	55	32	90	50
Out-of-State migrants:						
Plantations reporting	2	2	1	1	0	0
Average workers	23	23	20	20	0	0
Total cotton picking:						
Plantations reporting	23	23	21	21	22	22
Average workers	89	62	55	33	90	50

for cotton picking remained about the same (91 in 1953, 90 in 1957), while the usual number dropped from 62 in 1953 to 50 in 1957.

In 1957, the average number of acres of cotton per plantation on which nonresident labor was employed was 406 compared with 407 acres for all plantations. Corresponding acreages for 1953 were 734 and 718, respectively.

A comparison of the number of nonresident pickers and choppers employed during 1956, a representative or "normal" crop year, and the number in 1957, a year beset with "abnormal" weather during the growing and harvesting period[10], indicates the effect of weather on the demand for nonresident workers. The 1957 peak number of nonresident cotton choppers per plantation on which this type of labor was hired was about 25 percent greater than the 1956 peak and the usual number of nonresident choppers was about 24 percent higher. The peak number of nonresident hand-pickers in 1957 was about 64 percent greater than the 1956 peak number, and the usual number of pickers was 52 percent higher. This would indicate that plantation operators should have access to pools of nonresident pickers and choppers.

Tractor Drivers

In 1957, operators of the 40 large plantations reported a total of 439 tractor drivers, an average of 11 per plantation, or for each 37 acres of cotton. More than three-fifths (62 percent) of the tractor drivers came from resident wage families while the rest (38 percent) came from cropper families.

Tractor drivers were paid on hourly, weekly, and monthly bases. The most common hourly wage rate was 50 cents, and the most common daily and monthly rates were $5 and $100, respectively. Incentives for tractor drivers consisted of a year-end bonus and better housing. In the future, plantation workers with skills necssary for mechanized operation will continue to be in demand while the general laborer will have a less secure position.

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[10] See pp. 17 for a discussion of growing and harvesting conditions during 1956 and 1957.

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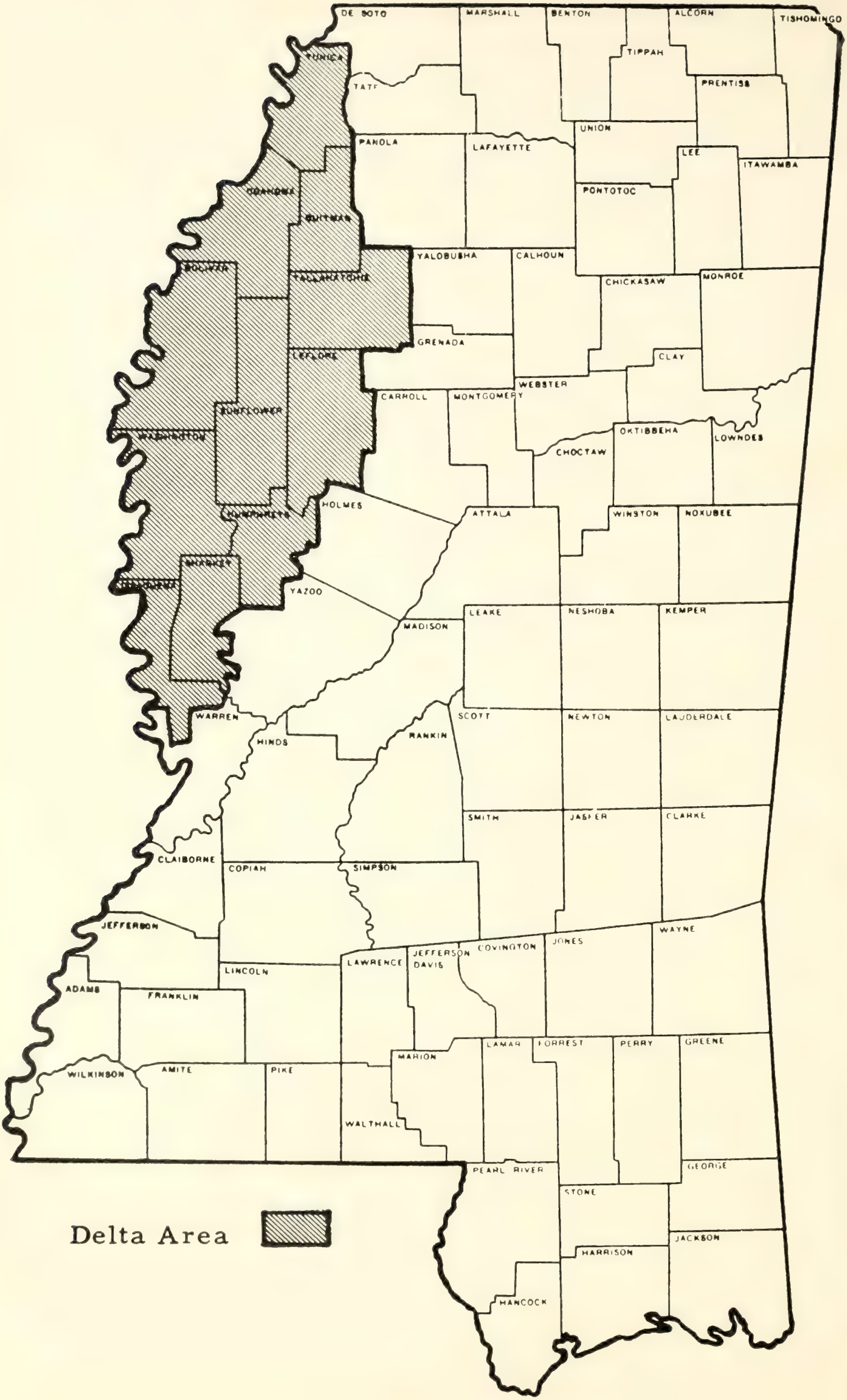
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BENTON
ALCORN
TISHOMINGO
TUNICA
TIPPAH
TATE
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
PONTOTOC
QUITMAN
YALOBUSHA
CALHOUN
BOLIVAR
TALLAHATCHIE
CHICKASAW
MONROE
GRENADA
LEFLORE
CLAY
WEBSTER
CARROLL
MONTGOMERY
SUNFLOWER
WASHINGTON
OKTIBBEHA
LOWNDES
CHOCTAW
HOLMES
HUMPHREYS
ATTALA
WINSTON
NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
SCOTT
NEWTON
LAUDERDALE
WARREN
RANKIN
HINDS
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
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LAMAR
FORREST
PERRY
GREENE
MARION
WILKINSON
AMITE
PIKE
WALTHALL
PEARL RIVER
GEORGE
STONE
Delta Area ▨
JACKSON
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BULLETIN 576 MAY 1959

Special Equipment For Chemical Weed Control

By O. B. WOOTEN and J. T. HOLSTUN, JR.

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SPECIAL EQUIPMENT FOR CHEMICAL WEED CONTROL

By O. B. Wooten[1] and J. T. Holstun, Jr.[2]
Delta Branch Experiment Station, Stoneville, Mississippi

Chemical weed control has become a reality within the last 10 years. This publication presents a discussion of the low-volume sprayer and its adaptations to meet requirements for specific chemical treatments. The descriptions and discussions are based on 10 years of research on weed spraying in the Yazoo-Mississippi Delta. Most of the findings and recommendations on the basic components of spray equipment are applicable to other areas in the state and in the Mid-South in general with slight modification of some components to suit local conditions. In the description of types of parts or assemblies, no criticism or endorsement of any manufacturer's product is intended.

Basically, all low-volume sprayers consist of a pump, tank, pressure regulator, pressure gauge, feed and return hoses, and delivery nozzles. Line strainers and nozzle strainers are usually added to reduce nozzle stoppage and pump damage. Specialization is accomplished by varying the type of nozzle tip and/or its placement while spraying. These and certain other aspects of spraying are covered in the following discussion.

The pump, which is the heart of the low-volume sprayer, is usually placed below the tank and starts the flow of material by creating a vacuum in the hose connecting it to the tank. Simultaneously, the pump creates pressure on the discharge side of the system. A line strainer (usually 50-mesh) should be placed in the intake hose to minimize damage to the pump by large abrasive particles.

There are several types of pumps available for agricultural use. The following factors should be considered in selecting a pump.

(1) The type of liquid to be sprayed. If abrasive materials, such as wettable powders, are used, it will be wise to consider either a piston or diaphragm pump. When emulsifiable concentrates are used, abrasion is not a factor and other types, such as gear and roller pumps, may be used.

(2) Parts and service facilities should be available if the pump is listed as repairable.

(3) Length of yearly usage should serve as a guide in determining the price that is justified for a pump. As a general rule, pumps that will deliver from 3 to 10 gallons per minute and develop 100 p.s.i. pressure will satisfactorily handle most spraying jobs.

Many pumps are severely damaged by hammering them on and off the power take-off shaft. The shaft should be cleaned with a steel brush to remove grease and dirt and if burrs or nicks are present, they should be removed with a fine file before installing the pump. A simple puller for removing pumps that seize the shaft is shown in figure 1. Removal with a hammer will frequently ruin the bearings.

Tanks

Tanks are now available in mild steel, stainless steel, aluminum, and plastic reinforced with fiberglass. Mild steel tanks, such as oil drums, should be equipped with oversize filler openings large enough for the removal of rust and scale. The tanks should be thoroughly cleaned and coated inside with oil before storage between seasons. Much of the trouble with clogged nozzles is caused by rust and

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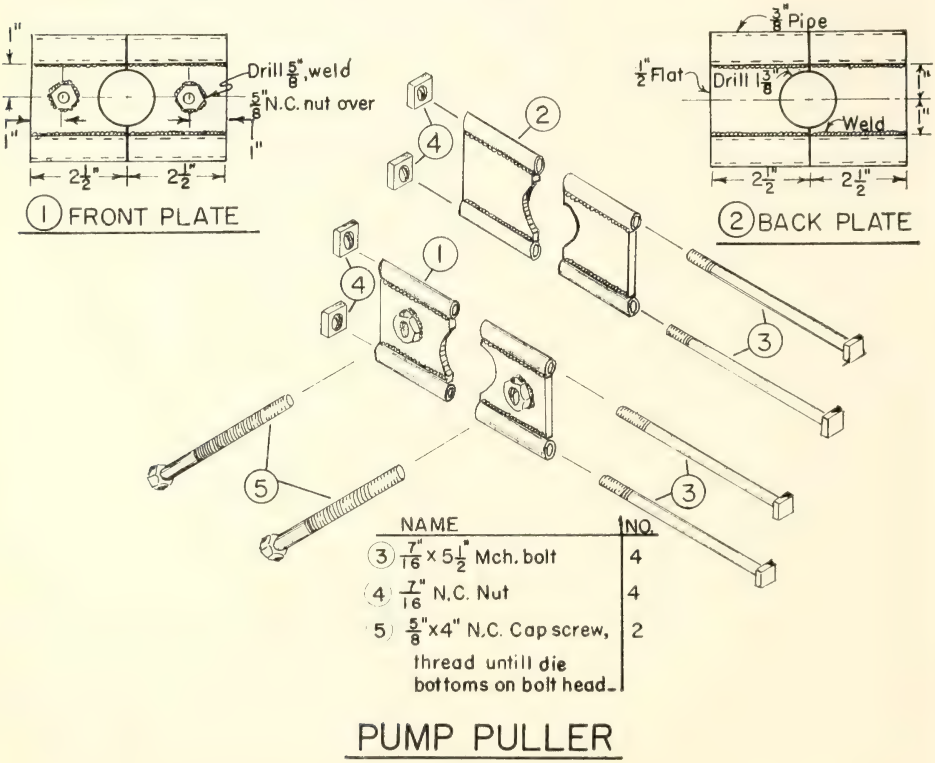
This report is based on research contributing to the Regional Cotton Mechanization Project S-2 and the Regional Weed Control Project S-18

scale which accumulates between spraying seasons.

The other three materials listed are more expensive than mild steel, but will withstand the corrosive action of currently recommended chemicals. In considering the kind of tank to purchase it will be wise to remember that the higher-cost tank materials will give added years of trouble-free spraying and may be more economical than the frequent cleaning and replacement of the cheaper iron tanks. Field usage has shown that nozzle stoppage will be negligible when corrosive-resistant materials are used in tank construction.

Most of the spray solutions require some agitation in the tank to keep them uniformly mixed. If spray materials are used that readily stay in solution or suspension after a good mixing, hydraulic agitation furnished by the bypass return is adequate. For highest efficiency of hydraulic agitation, the bypass line should be placed so that it discharges across the bottom of the tank rather than vertically from the top. If wettable powders that are difficult to keep in suspension are used, the tank should be equipped with a mechanical agitator. Adequate drains should be installed in the lowest part of the tank to facilitate rinsing and cleaning.



NAME	NO.
③ 7/16" x 5½" Mch. bolt	4
④ 7/16" N.C. Nut	4
⑤ 5/8"x4" N.C. Cap screw, thread untill die bottoms on bolt head.	2

Figure 1. Puller for 1-3/8-inch power take-off shaft. Form parts 1 and 2 by drilling and welding. Then cut each in half on the heavy center line as shown in details 1 and 2 above.

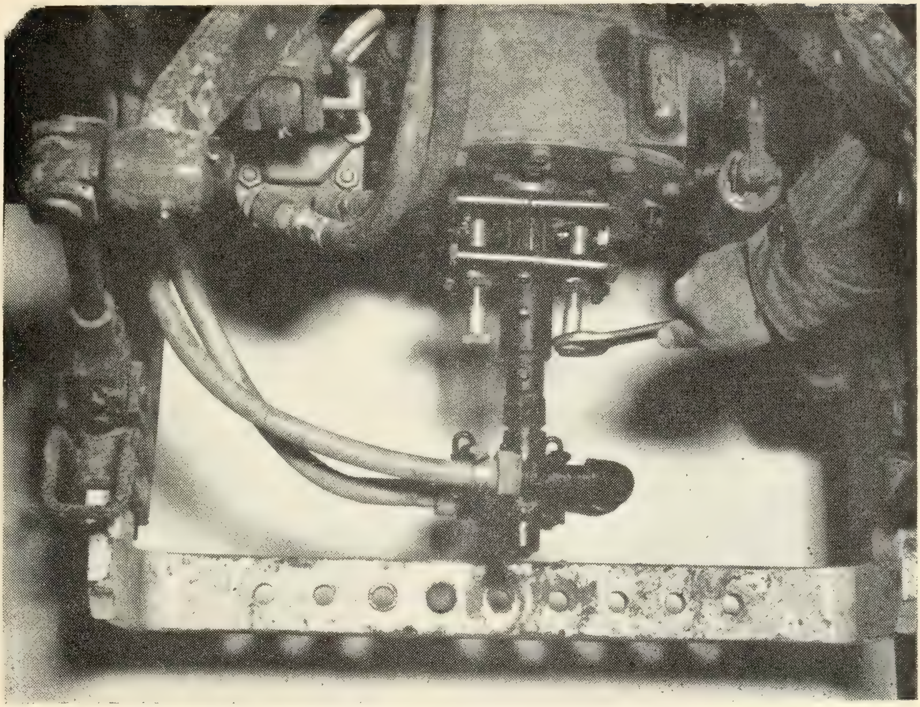


Figure 2. Removal of pump with puller. The backplate is placed over the power take-off shaft next to the bearing. The front plate is placed over the shaft with the nuts facing the pump. The 4 machine bolts are then tightened just past finger-tight. The 2 capscrews are alternately tightened until the pump coupling slides free on the shaft.

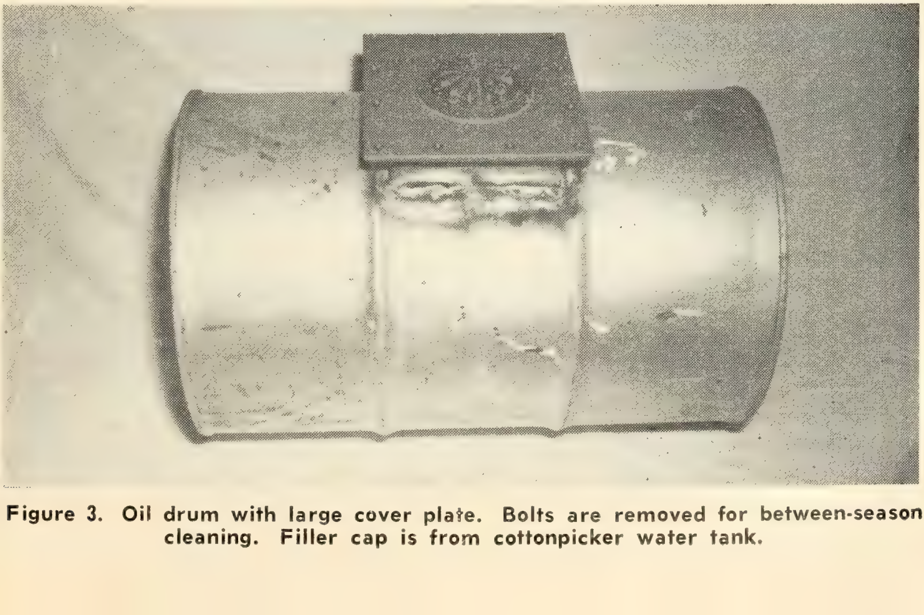


Figure 3. Oil drum with large cover plate. Bolts are removed for between-season cleaning. Filler cap is from cottonpicker water tank.

Regulators

The pressure regulator is located on the discharge side of the pump. The liquid is divided in the pressure regulator to feed both the nozzles and the bypass line. All liquid in excess of that needed to maintain the desired pressure in the nozzle-feed hose is shunted into the bypass line, which returns it to the tank.

Two types of by-pass pressure regulators are generally available for pressure regulation for low-volume, low-pressure spraying. One type incorporates a spring over a ball and seat. The other type includes a spring, diaphragm, plunger, and seat. Both types have an adjusting screw to regulate pressure. Both types of regulators are satisfactory, but the diaphragm and spring type will require less adjustment and attention by the operator in maintaining a constant pressure.

Gauges

The pressure gauge should be placed in the hose between the pressure regulator and the delivery nozzles. Gauges with a range of 0 to 100 p.s.i. are satisfactory for most spraying operations. The scale should be in small divisions to facilitate easy and accurate calibration of the sprayer.

Hoses

The hose on the intake side of the pump should be large enough to avoid starving the pump and lowering its efficiency and not less than ½ inch in diameter. The discharge hose leading from the pump to the pressure regulator and the bypass hose should be of the same size as the intake hose. The discharge hose leading from the pressure regulator to the nozzles need not be as large as the intake hose, but it should be large enough to adequately feed at least twice the number of nozzles being used (to reduce pressure-drop at the more distant nozzles). It should be remembered that the effective size of any hose is no larger than the smallest bore of any fitting placed in it.

The hoses should be arranged in smooth curves, avoiding sharp kinks. In cases where dual tanks are used, individual hoses and valves must be used, since two tanks do not crossfeed evenly into a common intake. Lead-offs from manifold hoses on the discharge side should be of equal diameter and length.

Synthetic rubber materials that are resistant to aromatic solvents should be used for the sprayer hoses. Polyethylene tubing is now being used to a limited extent for spray hose. This material is resistant to many chemicals; however, the service life under exposure to the ultraviolet rays of the sun has not been estabilshed.

Booms — Broadcast

Three types of broadcast booms are shown in figure 4.

1. The wet boom shown at the top of figure 4 employs either a pipe or tubing to transport the liquid. Usually a pipe coupling is welded, brazed, or soldered over holes spaced from 18 to 20 inches apart to supply the nozzle. There are several disadvantages in using this type of boom. If the boom is iron, it presents corrosion problems which lead to excessive nozzle stoppage. In addition, accidental bending and metal fatigue tend to cause leaks around the fittings. These leaks are hard to repair because of the difficulty in cleaning the surfaces in preparation for welding.

2. The wet boom in the center is satisfactory. It is easily constructed and easily repaired. If the pipe used is resistant to corrosion, nozzle stoppage is reduced. Holes are drilled in the pipe to the size specified by the manufacturer. The tubes in the eyelets are inserted through these holes and the screws are then tightened. The gaskets seal the fittings against leaks and no welding is required.

3. The boom at the bottom of figure 4 is referred to as a dry boom because the supporting member does not carry the liquid. This type has proven very satisfactory. It can usually be straightened

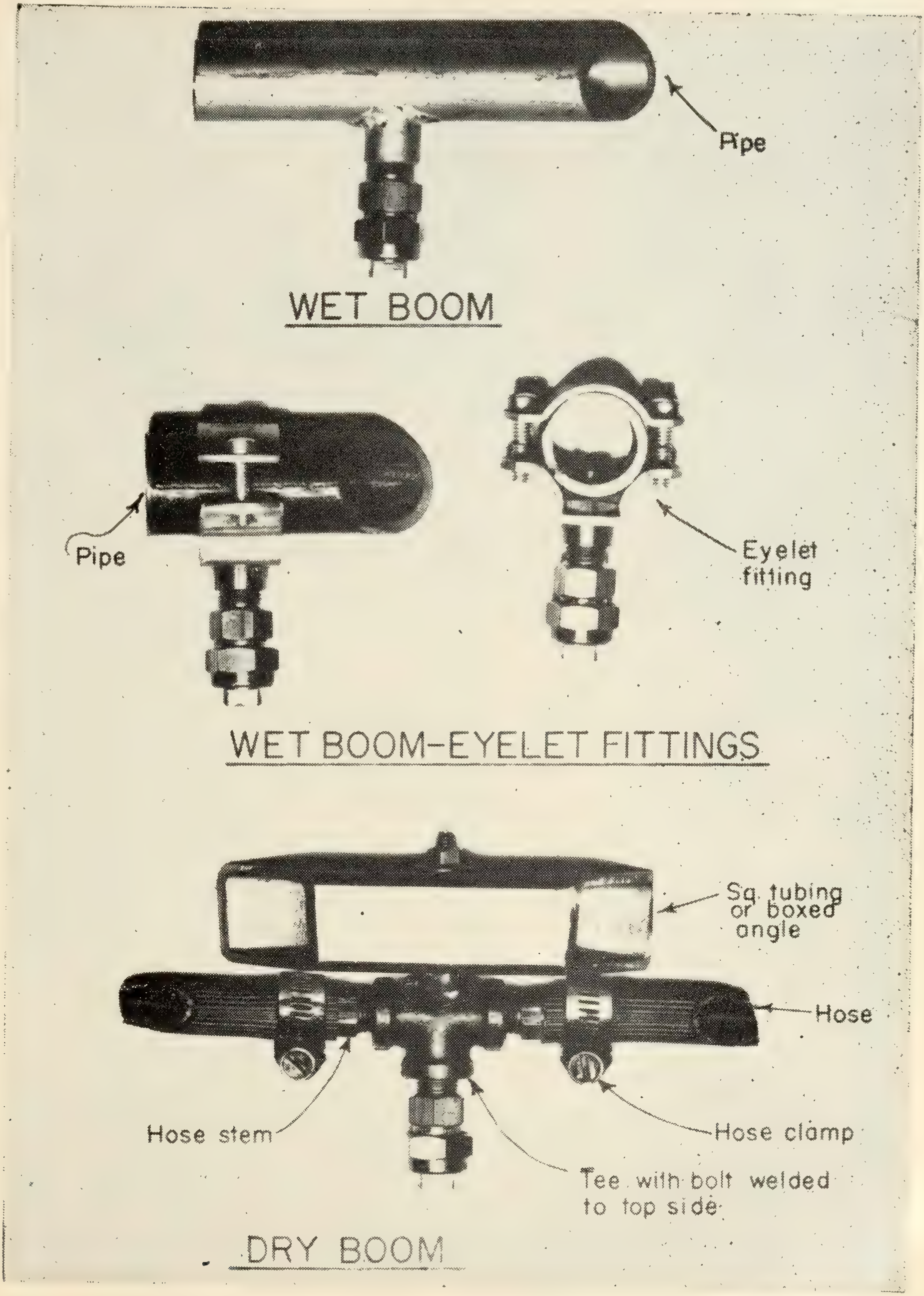

Pipe
WET BOOM
Pipe
Eyelet fitting
WET BOOM–EYELET FITTINGS
Sq. tubing or boxed angle
Hose
Hose stem
Hose clamp
Tee with bolt welded to top side
DRY BOOM

Figure 4. Sections of 3 basic types of spray booms

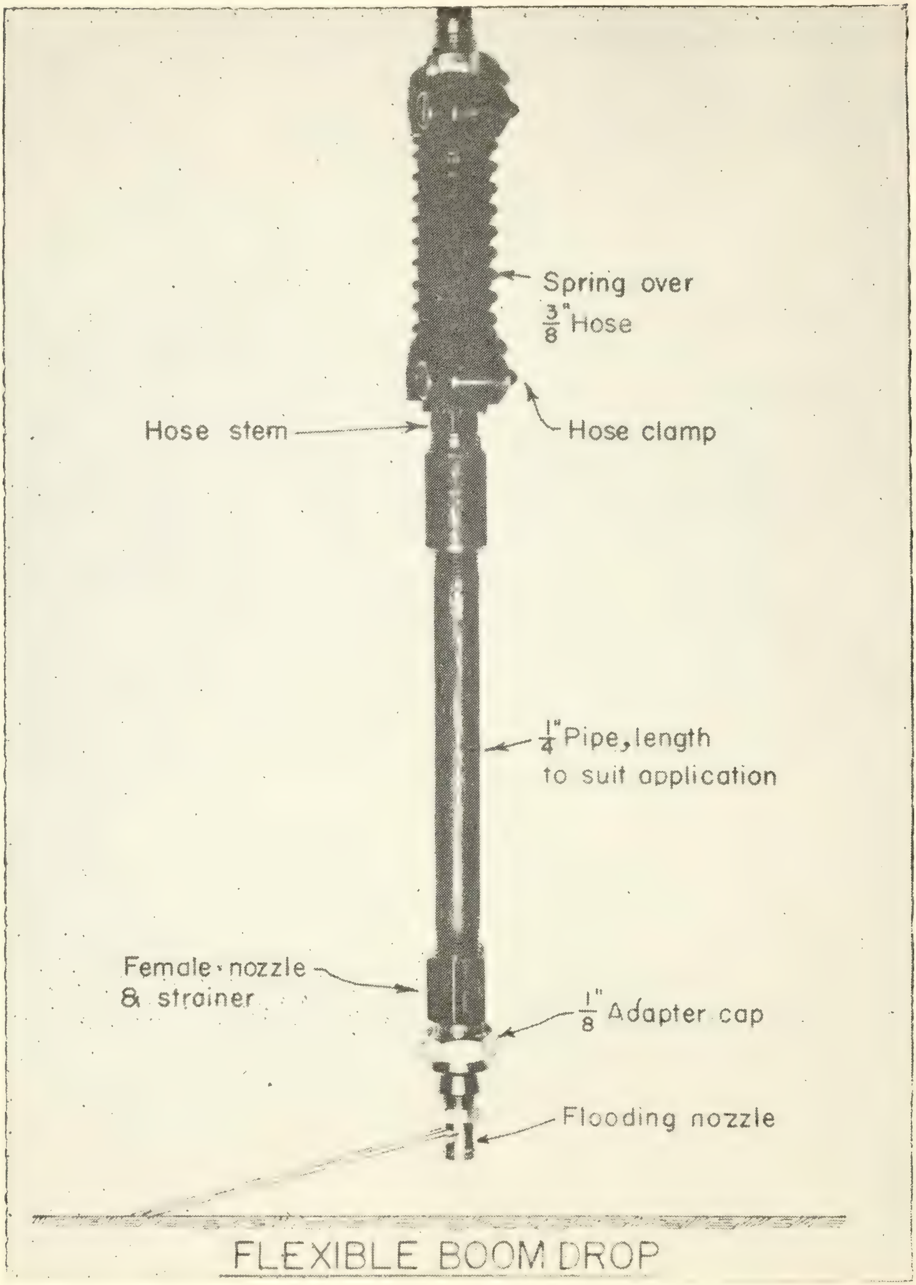

Spring over
$\frac{3}{8}$" Hose
Hose stem
Hose clamp
$\frac{1}{4}$" Pipe, length
to suit application
Female nozzle
& strainer
$\frac{1}{8}$" Adapter cap
Flooding nozzle
FLEXIBLE BOOM DROP

Figure 5. This type drop has flexibility with a spring to hold it in the vertical position. The spring shown is an automotive type for valves. The inner diameter is approximately 1/8 inch larger than the outside of the hose.

after accidental bending without leakage. Corrosion does not present a problem because the liquid is carried in hoses from fitting to fitting. The supporting member is either square tubing or two angles placed together and welded to form a box beam. Other shapes, such as round tubing or angles can be used satisfactorily. Holes are drilled 18, 19, or 20 inches apart to hold the outlet. The outlets are pipe tees with bolts welded to the back side.

The male nozzle bodies shown in figure 4 can be replaced with flexible boom drops as illustrated in figure 5. The drop pipes (figure 5) are made of readily available ¼-inch pipe. By having several sets of drop pipes of varying lengths, one spray machine can be quickly changed for spraying crops of many different heights.

Nozzles

The nozzle shown in the photograph (figure 5) is a flooding nozzle. This nozzle has an extremely large spray angle at low pressures with a minimum amount of atomization. One nozzle suspended in the middle between rows can obtain full coverage of a 40-inch row for post-emergence application. These nozzles can be placed close to the ground between the rows and can be operated in a pressure range of 20 to 35 p.s.i. This will hold drift to a minimum by reducing the number of small droplets.

Other types of nozzles can be used on the end of the drop pipe. Likewise, an elbow, tee, or Y fitting can be added to the end of the drop pipe to add more nozzles per row or make possible almost any desired positioning of the nozzle tip.

Boom or Broadcast: Fan nozzles for this type spraying have light edges to produce an even pattern when they lap on the surface under the boom. No drop pipes are used as the nozzles are equally spaced on the boom to give uniform flat coverage of the swath being sprayed.

Boomless: This refers to a cluster of nozzles in a single unit for broadcast spraying. These nozzles cover a wide swath under calm wind conditions. They are excellent for spraying on rough terrain, such as pastures or where brush is encountered. They should not be used under high wind conditions because of pattern distortion.

In most boom spraying the nozzles are perpendicular to the ground line. It is often desirable to rotate the cluster of nozzles making up the boomless 45° back from vertical. This allows the unit to operate closer to the ground, reducing pattern distortion and drift.

Post-emergence: Even-pattern or light-edge tips may be used for many post-emergence spraying operations including those operations performed with the equipment illustrated in figures 5-10. For complete row and middle coverage, consideration should be given to the use of the wide-angle flooding nozzles shown in figure 5.

Pre-emergence: Even-pattern fan tips are recommended for this kind of spraying. The nozzles are supported by a simple bracket centered over the seed furrow directly behind the planter press wheel. The nozzles must be adjustable for height. The height above ground (to spray a 12-inch band) for a fan nozzle with an 80° spray angle will vary from 7½ inches at 30 p.s.i. to 6½ inches at 60 p.s.i.

Shoes for Directed Post-Emergence Spraying

Two types of shoes are described for a closely controlled directed spray for row crops. Both types use parallel linkage to maintain the spray in a horizontal plane. The first shoe is a light-weight flat shoe that is attached to the standard of shield type sweeps. The shoes are fabricated one right and one left per row and are run in front of the sweep.

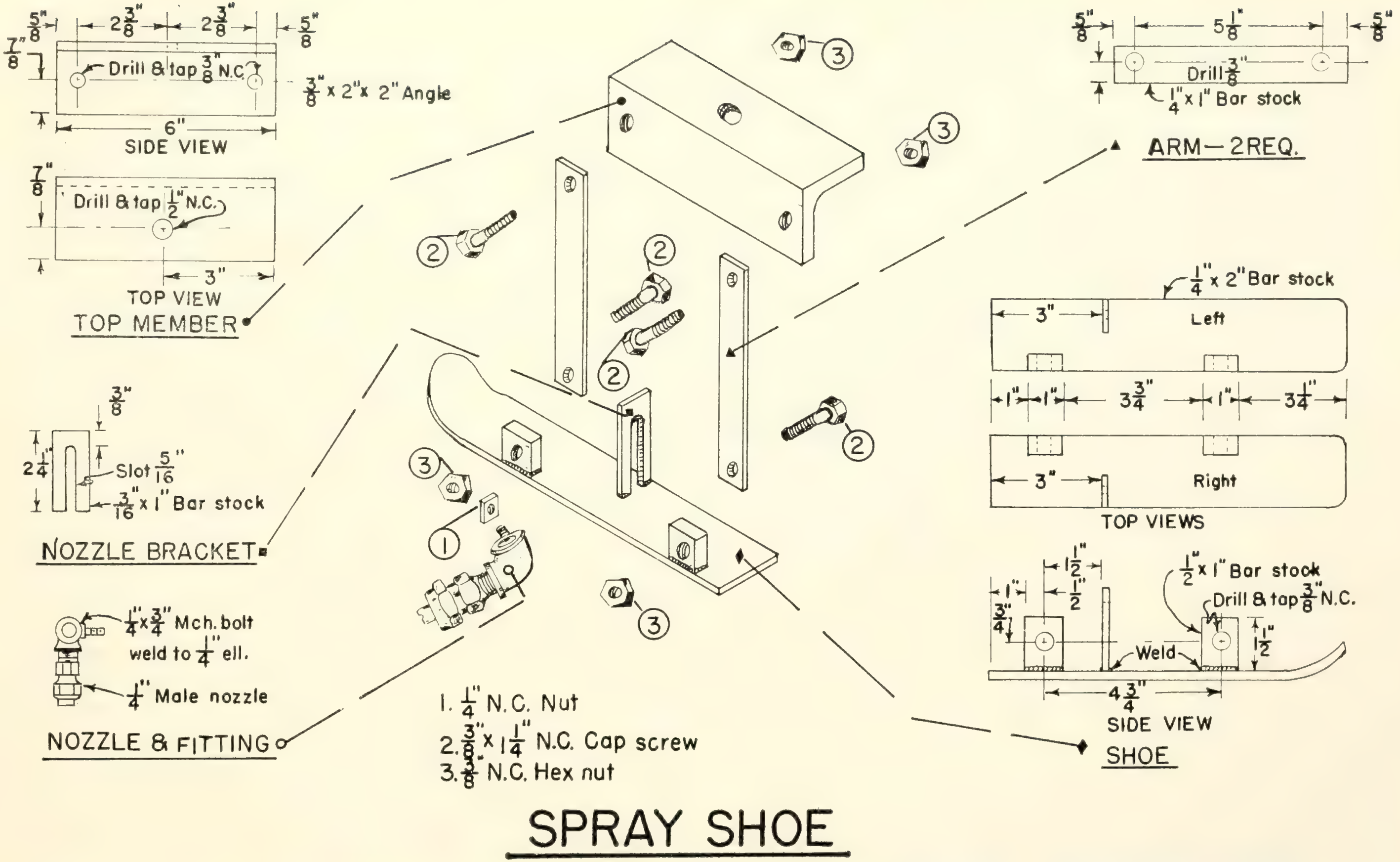

5/8"
2 3/8"
2 3/8"
5/8"
7/8"
Drill & tap 3/8" N.C.
3/8" x 2" x 2" Angle
6"
SIDE VIEW
7/8"
Drill & tap 1/2" N.C.
3"
TOP VIEW
TOP MEMBER
3/8"
2 1/4"
Slot 5/16"
3/16" x 1" Bar stock
NOZZLE BRACKET
1/4" x 3/4" Mch. bolt weld to 1/4" ell.
1/4" Male nozzle
NOZZLE & FITTING
1
2
3
1. 1/4" N.C. Nut
2. 3/8" x 1 1/4" N.C. Cap screw
3. 3/8" N.C. Hex nut
SPRAY SHOE
5/8"
5 1/8"
5/8"
Drill 3/8"
1/4" x 1" Bar stock
ARM—2 REQ.
1/4" x 2" Bar stock
3"
Left
1"
1"
3 3/4"
1"
3 1/4"
3"
Right
TOP VIEWS
1 1/2"
1"
1/2"
3/4"
1/2" x 1" Bar stock
Drill & tap 3/8" N.C.
1 1/2"
Weld
4 3/4"
SIDE VIEW
SHOE

Figure 6. Post-emergence spray application shoe for use in conjunction with shield-type sweeps.

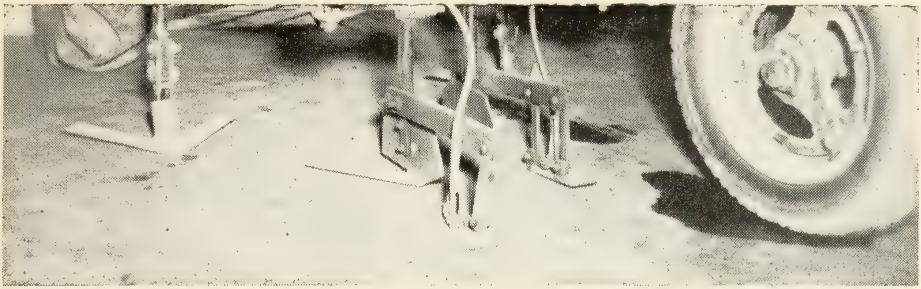
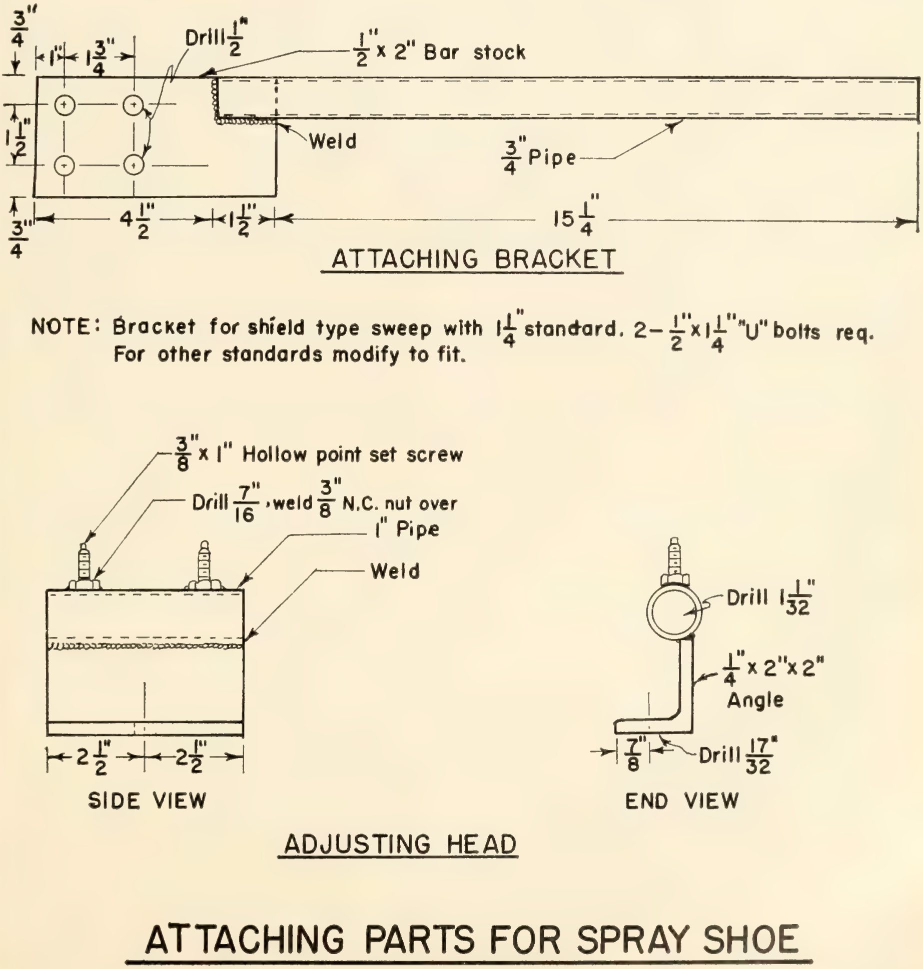


Figure 7. Parallel-action spray shoe mounted on shank of shield-type sweep.



3/4"
1" 1 3/4"
Drill 1/2"
1/2" x 2" Bar stock
1 1/2"
Weld
3/4" Pipe
3/4"
4 1/2"
1 1/2"
15 1/4"
ATTACHING BRACKET
NOTE: Bracket for shield type sweep with 1 1/4" standard. 2 – 1/2" x 1 1/4" "U" bolts req. For other standards modify to fit.
3/8" x 1" Hollow point set screw
Drill 7/16", weld 3/8" N.C. nut over
1" Pipe
Weld
2 1/2"
2 1/2"
SIDE VIEW
Drill 1 1/32"
1/4" x 2" x 2" Angle
7/8"
Drill 17/32"
END VIEW
ADJUSTING HEAD
ATTACHING PARTS FOR SPRAY SHOE

Figure 8. Bracket to attach shoe to standard of shield-type sweeps.

The bearings of the shoes are capscrews. The capscrews are placed through the arms and screwed into the tapped holes in the posts and top member. They are tightened until there is a very light drag when the arms are moved. The locknuts are then tightened. This type bearing allows for tightening to compensate for wear. Details of this shoe are shown in figure 6. The attaching bracket is shown in figure 8.

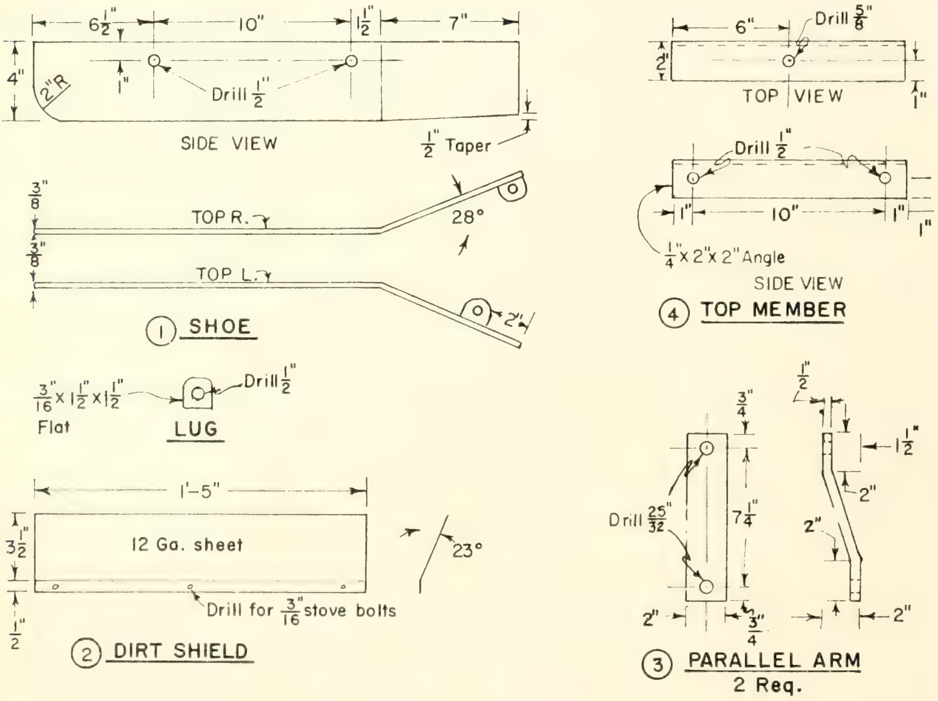
The second type shoe is a shield used in conjunction with low-crown high-speed sweeps. Details of this type shoe and attaching bracket are shown in figures 9 and 10. The bearings are capscrews through a spacer bushing in all hinge points.

Both types of shoes are set to have a light bearing with the soil on the row when the sweep is at working depth. The shoes are staggered to keep the sprays from striking each other.

Full instructions as to nozzle location, calibration, and materials to use are given in the current weed control recommendations (Mississippi Agricultural Experiment Station Bulletin 556).

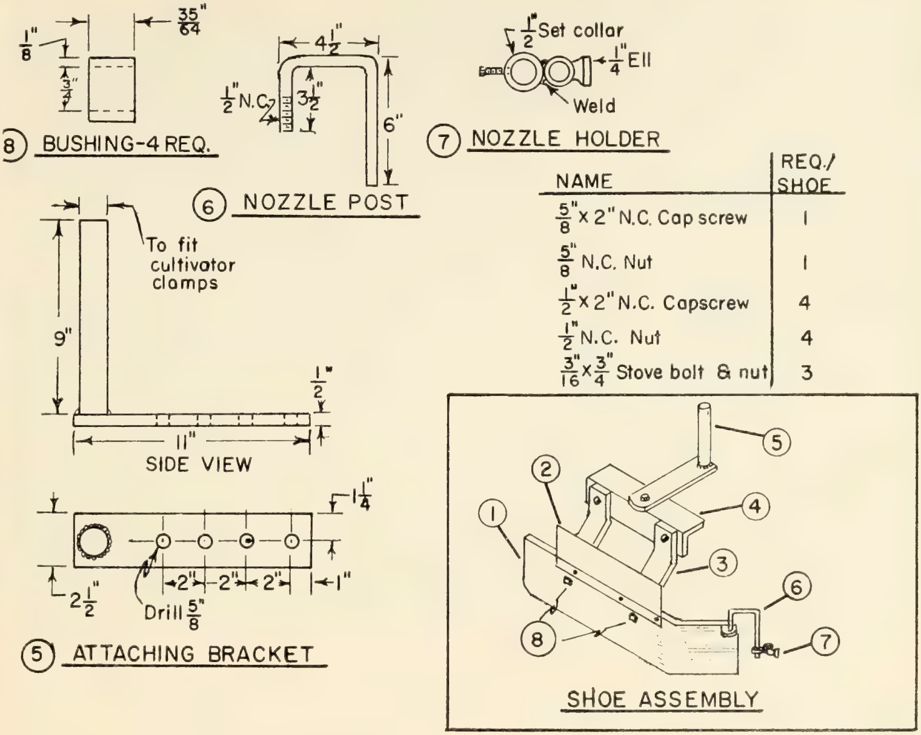
Refilling the Sprayer

One of the big problems in spraying is reloading without excessive loss of time. This is particularly true with the pre-emergence operation where the sprayer is carried on the planting tractor. One solution to this problem is the use of a trailer tank unit for mixing and loading operations. The unit shown in figure 11 is a towed unit consisting of a tank, engine, high-pressure pump, strainers, and


6½"
10"
1½"
7"
4"
2"R
1"
Drill ½"
SIDE VIEW
½" Taper
3/8"
TOP R.
28°
3/8"
TOP L.
2"
① SHOE
3/16" x 1½" x 1½"
Flat
Drill ½"
LUG
1'-5"
3½"
12 Ga. sheet
23°
½"
Drill for 3/16" stove bolts
② DIRT SHIELD
6"
Drill 5/8"
2"
TOP VIEW
1"
Drill ½"
1"
10"
1"
1"
¼" x 2" x 2" Angle
SIDE VIEW
④ TOP MEMBER
½"
¾"
1½"
2"
Drill 25/32"
7¼"
2"
2"
¾"
2"
③ PARALLEL ARM
2 Req.

SHIELD APPLICATOR

Figure 9. Construction plan for shield applicator for post-emergence spraying.


1/8"
35/64"
3/4"
8 BUSHING-4 REQ.
4 1/2"
1/2" N.C.
3 1/2"
6"
6 NOZZLE POST
1/2" Set collar
1/4" Ell
Weld
7 NOZZLE HOLDER
To fit cultivator clamps
9"
1/2"
11"
SIDE VIEW
1 1/4"
2 1/2"
2"
2"
2"
1"
Drill 5/8"
5 ATTACHING BRACKET
1
2
3
4
5
6
7
8
SHOE ASSEMBLY

NAME	REQ./ SHOE
$\frac{5}{8}$" x 2" N.C. Cap screw	1
$\frac{5}{8}$" N.C. Nut	1
$\frac{1}{2}$" x 2" N.C. Capscrew	4
$\frac{1}{2}$" N.C. Nut	4
$\frac{3}{16}$" x $\frac{3}{4}$" Stove bolt & nut	3

Figure 10. Attaching bracket for shield applicator shown in figure 9.

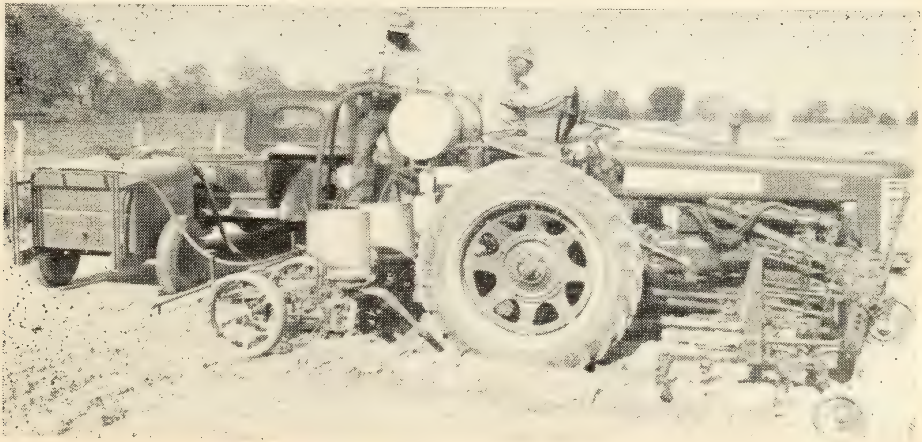


Figure 11. Refilling the pre-emergence sprayer with a trailer-mounted tank and pumping unit.

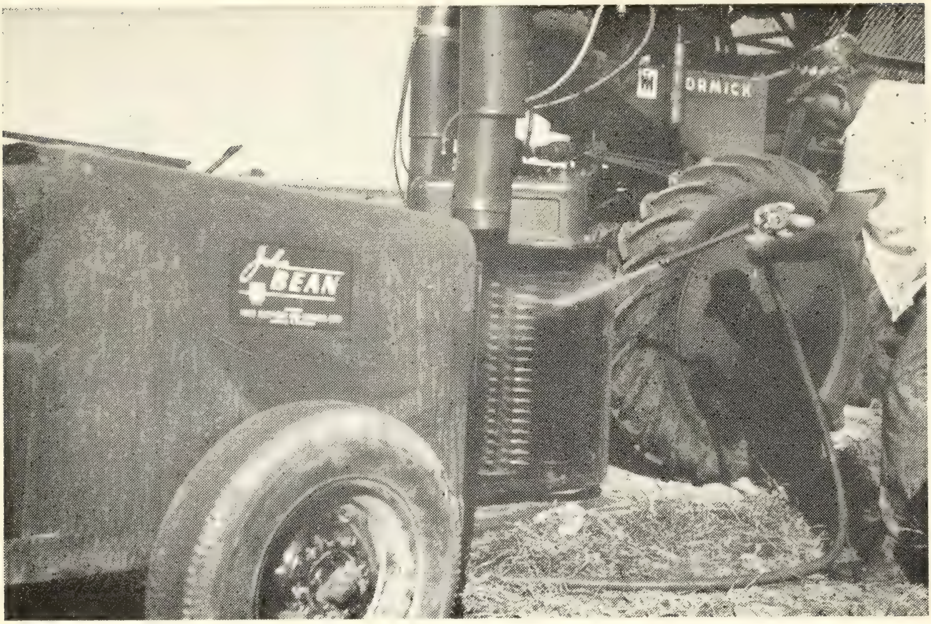


Figure 12. Cleaning cottonpicker drum with trailer tank and pumping unit.

filling hose equipped with a Venturi attachment. The Venturi attachment greatly increases the output of the pump.

The tank is equipped with mechanical agitation which will insure a good mixture for transfer to the field sprayer. Since the majority of sprayers are equipped with hydraulic agitation, this feature should help to obtain uniform chemical application. This type loading unit can be trailer-mounted or truck-mounted, and can service one or more sprayers satisfactorily. It is available in several sizes.

These units can have year-round service. They can be used as ditchbank sprayers, orchard sprayers, cattle sprayers, loading units for other spraying operations, cleaning cottonpicker drums (figure 12), and filling cottonpicker water tanks.

BULLETIN 577 MAY 1959

Estimated Population Trends In Mississippi, 1950-1958

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STATE COLLEGE MISSISSIPPI

ESTIMATED POPULATION TRENDS IN MISSISSIPPI, 1950-58

By GEORGE L. WILBER and CARL T. ROBBINS

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GENERAL TRENDS

Mississippi's population in 1958 was estimated at 2,184,000, essentially the same size as in 1940 and only 0.2 percent larger than in 1950. During the 7 3/4 years from April, 1950 to January 1, 1958, the date of the present estimate, there were about 500,000 births and 160,000 deaths in the state. With no migration the population should have increased by about 340,000. Actually, in the process of interstate migration, Mississippi lost a third of a million persons. Loss of Mississippians through migration is not a new development, since for over five decades net outmigration has been prominent.

The white population of Mississippi increased by 68,000 from 1950 to 1958, an increase of 5.7 percent. But there were 140,000 more births than deaths among whites, so approximately 72,000 were lost through migration. By 1958 whites represented 57.5 percent of the population, as compared with 54.6 percent in 1950.

Nonwhites showed a net loss of over 69,000, or a decrease of 9.0 percent, but without any migration should have increased by more than 200,000, the difference between births and deaths. Net migration losses thus were much heavier from 1950 to 1958 among nonwhites than whites.

PROCEDURE FOR ESTIMATION OF POPULATION

In making the estimates of Mississippi's population for 1957 and 1958, the "vital rates" method was used.[1] Briefly, this procedure involves averaging two independent and provisional estimates, one based upon births and the other upon deaths. To obtain an estimated population for a county, births were averaged over a three-year period, from 1949 through 1951. This average number of births was then used as a basis for calculating the birth rate for 1950, which in turn was used to determine the ratio of the county's birth rate to the state birth rate for the year of estimate, for example 1958. This ratio was then multiplied by the calculated birth rate for the year of estimate to provide an adjusted birth rate. Finally the number of births for the estimate year was multiplied by the adjusted birth rate to obtain a provisional estimate of the county's population. Following the same procedure, a second estimate was obtained by using death statistics. The two independent estimates were averaged to obtain the final estimate of population.

As with any estimating procedure, the vital rates method is based upon certain assumptions. (1) It was assumed that by averaging estimates based upon births and deaths that extreme variations would be reduced. (2) Since migration is not accounted for specifically in utilizing births and deaths as bases for estimates, it was assumed that changes in the number of people moving into or away from a county would be reflected by numbers of births and deaths. If, for example, a large number of young married couples were to move into a particular county, the birth rate would be expected to increase. Or, if a

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[1] For details of this method see Donald J Bogue, "A Technique for Making Extensive Population Estimates," **Journal of the American Statistical Association,** 45 (June 1950), 149-163.

number of older people were to move away, the death rate would probably go down. (3) It was assumed further that county birth and death trends would not differ greatly from those of the state as a whole. The date of the estimate is January 1 of the year of estimate, 1957 or 1958 as the case may be (see Appendix Tables). Census figures for 1950 are for April. Consequently, for careful and detailed study it may be important to pay strict attention to the precise date of census enumerations or estimates.

RELIABILITY OF THE POPULATION ESTIMATES

Accuracy of the estimates obtained by the vital rates method is uncertain. At least one study has found, however, that vital rates estimates are generally as dependable as estimates by other means.[2] If vital rates estimates are biased, they probably overstate rather than understate the size of population.

As a general rule it appears that estimates for larger populations are more reliable than those for smaller populations. For populations smaller than 10,000 the estimates must be interpreted cautiously. Estimates for the white population should be more accurate than estimates of the nonwhite because births and deaths are generally recorded more accurately for white than nonwhites. Estimates for certain counties were erratic for reasons that could not be identified readily. Such erratic estimates were found for the following counties for 1957 and 1958 (see Appendix Tables):

Amite
Choctaw
Claiborne
Grenada
Jasper
Jefferson
Lawrence
Leake
Montgomery
Pearl River
Pike
Rankin
Scott
Stone
Tishomingo
Walthall
Warren
Washington
Wayne

For these counties, estimates of population appeared inconsistent from year to year, or annual reports of births and deaths showed irregular patterns.

VARIATIONS IN POPULATION CHANGE

Gulf Coast Counties Grow

Counties with high rates of growth are found in several parts of the state, but counties along the Gulf Coast showed the most outstanding upsurge in population. Of ten counties in the Gulf Coast region, seven showed an increase between 1950 and 1958 (Table 1). Harrison County almost doubled its population, with an increase of 96.3 percent, followed by Jackson and George counties, with increases of 87.9 and 59.8 percents respectively. Of these three tiers of counties nearest the Gulf Coast, only Perry, Greene and Stone counties lost population ,and these three are relatively rural areas.

Commercial and industrial expansion of Biloxi, Gulfport and Pascagoula appears largely responsible for the phenomenal growth of the coastal population.

A major source of the increased population in the coastal counties is attributable to an influx of nonwhites. For nine of the ten months the nonwhite population increased more than the white and in the tenth county, Perry, the loss of nonwhites was less than for whites. In 1950 these coastal counties contained fewer than the state average of nonwhites. This is one reason why percentage increases for nonwhites appear as large as they do.

Delta Counties Lose Population

In contrast with the increase in population of the coastal counties, the Delta counties — those served by the Delta

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[2] See Jacob S. Siegel, et al, "Accuracy of Postcensal Estimates of Population for States and Cities, "**American Sociological Review**, 19 (August 1954), 440-446.

Table 1. Percentage change of Mississippi coastal counties, 1940-1950, and by race, 1950-1958.

County	1940-50	1950-58		
		Total	White	Nonwhite
Hancock	5.0	0.9	—6.6	37.3
Harrison	65.5	96.3	88.2	138.4
Jackson	52.4	87.9	64.2	174.6
Pearl River	7.9	35.7	23.9	78.1
Stone	1.8	—4.2	—8.1	9.9
George	15.0	59.8	59.4	62.5
Lamar	9.3	43.7	39.4	66.2
Forrest	29.1	13.2	9.1	23.4
Perry	—2.0	—15.5	—20.3	—0.5
Greene	—13.6	—5.1	—9.1	13.0

Table 2. Percentage of change of Mississippi Delta counties, 1940-50, and by race, 1950-58.

County	1940-50	1950-58		
		Total	White	Nonwhite
Bolivar	—6.8	—38.1	—24.5	—44.4
Carroll	—24.9	—35.5	—38.5	—33.2
Coahoma	2.1	—19.0	9.5	—29.9
De Soto	—7.7	—6.5	17.6	—18.3
Holmes	—16.1	—27.9	—22.9	—29.7
Humphreys	—12.0	—30.8	—30.1	—31.1
Issaquena	—22.8	—25.5	11.3	—43.3
Leflore	—3.0	—22.8	—21.1	—23.6
Panola	—9.2	—7.3	—5.7	—8.5
Quitman	—4.8	—26.6	—34.2	—21.7
Sharkey	—16.4	—28.7	—19.2	—32.6
Sunflower	—8.2	—23.3	—10.5	—29.2
Tallahatchie	—10.8	—27.8	—18.8	—33.0
Tate	—6.7	—5.6	17.8	—22.9
Tunica	—4.2	—26.1	—49.2	—21.0
Warren	0.1	—6.6	—2.7	—10.4
Washington	4.3	—10.6	10.9	—21.4
Yazoo	—10.9	—21.6	—19.3	—23.0

Council—lost population between 1950 and 1958 without exception. The eighteen Delta counties lost a total of 129,000 people, 22,000 white and 107,000 nonwhite. Since as far back as 1940 the Delta area has been losing population (Table 2). During the 1940's the Delta population declined by 42,685. Whereas nonwhites increased more than whites in the coastal counties, the opposite condition was found for the Delta area. With the exception of three Delta counties, nonwhite percentage losses exceeded the total percentage loss for the county. Historically nonwhites have constituted the labor force in the plantation economy of the Delta. With increased mechanization and improved farming practices, requirements for labor have been reduced. Technological changes therefore explain a major part of the declining population of the Delta area.

Differences in Growth Rates

In addition to these regional variations in population change in Mississippi, counties may be grouped according to the rate of change from 1950 to 1958. Table 3 shows the rank order of counties by the percentage change in population from 1950 to 1958. Harrison County increased by 96.3 percent for the highest rate of increase while Bolivar County showed a loss of 38.1 percent for the greatest decrease. Counties may be grouped by rate of population change into five following categories:

Large increase	10.0% or more gain
Moderate increase	3.0% to 9.9% gain
Stable; no change	2.9% gain or loss
Moderate loss	3.0% to 9.9% loss
Large loss	10.0% or more loss

Seventeen counties showed a large increase and an additional seven a moderate increase. Of those showing population loss, 33 experienced large losses and 18 moderate losses. The 7 remaining counties were relatively stable, either gaining or losing less than 3 percent. The 24 counties with growing populations therefore had to increase enough to offset losses suffered by 51 counties for the state to show an increase.

The five most rapidly growing counties were in the Gulf Coast area. Among the 12 other counties of large population increase, several were urban counties. The Jackson Metropolitan Area, including all of Hinds County, increased by 23.8 percent, and neighboring Rankin County, increased by 24.6 percent. Lafayette, with an increase of 22.8 percent, is the home of the University of Mississippi. Lee

Table 3. Rank order of Mississippi counties by percentage change in total population, 1950-1958, and percentage change by race.

County	Total	White	Nonwhite
Harrison	96.3	88.2	138.4
Jackson	87.9	64.2	174.6
George	59.8	59.4	62.5
Lamar	43.7	39.4	66.2
Pearl River	35.7	23.9	78.1
Benton	25.1	2.9	45.5
Rankin	24.6	44.6	2.4
Hinds	23.8	36.7	8.0
Lafayette	22.8	29.2	11.3
Itawamba	22.0	22.2	17.4
Union	18.4	14.3	37.5
Jones	15.3	13.7	19.8
Lee	15.1	16.0	12.6
Forrest	13.2	9.1	23.4
Covington	12.2	— 3.0	43.9
Webster	12.0	12.2	11.4
Simpson	10.0	10.0	10.0
Oktibbeha	9.9	18.9	0.4
Jefferson Davis	9.7	42.2	—16.4
Tishomingo	9.4	12.2	—38.0
Marion	8.5	2.7	19.2
Lowndes	8.3	18.3	— 2.2
Pontotoc	5.0	— 1.1	31.0
Amite	3.8	— 8.2	14.0
Adams	2.3	23.8	19.3
Leake	1.8	4.5	— 1.8
Clay	1.4	30.5	—20.8
Hancock	0.9	— 6.6	37.3
Choctaw	— 0.1	— 2.3	5.1
Alcorn	— 0.6	— 9.7	53.7
Neshoba	— 2.8	—14.0	29.0
Tippah	— 3.0	—11.5	32.6
Montgomery	— 3.2	— 7.8	2.8
Walthall	— 3.6	7.2	—16.3
Prentiss	— 4.1	— 8.5	28.6
Stone	— 4.2	— 8.1	9.9
Greene	— 5.1	— 9.1	13.0
Lawrence	— 5.1	6.6	—24.3
Tate	— 5.6	17.8	—22.9
Wayne	— 5.9	— 7.3	— 3.5
DeSoto	— 6.5	17.6	—18.3
Warren	— 6.6	— 2.7	—10.4
Panola	— 7.3	— 5.7	— 8.5
Calhoun	— 7.5	—21.9	39.8
Scott	— 7.8	— 2.5	—14.6
Lauderdale	— 8.1	— 9.3	— 5.9
Copiah	— 8.2	— 1.5	—14.0
Marshall	— 8.4	—13.2	— 6.4
Grenada	— 9.7	—10.0	—9.5
Winston	—10.0	—15.0	— 3.3
Jasper	—10.1	0.1	—19.7
Chickasaw	—10.3	—23.0	— 5.6
Smith	—10.4	—21.3	32.7
Washington	—10.6	10.6	—21.4
Jefferson	—11.6	— 3.0	—14.5
Pike	—11.8	— 7.4	—17.2
Lincoln	—14.0	—14.5	—12.9
Yalobusha	—14.4	—17.9	— 9.9
Perry	—15.5	—20.3	— 0.5
Claiborne	—16.3	3.0	—22.8
Clarke	—17.4	—15.5	—20.1
Monroe	—17.9	—21.2	—12.5
Coahoma	—19.0	9.5	—29.9
Newton	—20.6	—19.1	—23.6
Franklin	—21.3	—27.5	—11.7
Yazoo	—21.6	—19.3	—23.0
Leflore	—22.8	—21.1	—23.6
Sunflower	—23.3	—10.5	—29.2
Kemper	—24.5	—18.0	—29.0
Attala	—25.0	—23.8	—26.5
Issaquena	—25.5	11.3	—43.3
Tunica	—26.1	—49.2	—21.0
Madison	—26.2	—32.8	—23.8
Quitman	—26.6	—34.2	—21.7
Tallahatchie	—27.8	—18.8	—33.0
Holmes	—27.9	—22.9	—29.7
Sharkey	—28.7	—19.1	—32.6
Wilkinson	—29.2	—31.2	—28.3
Noxubee	—30.1	7.5	—43.0
Humphreys	—30.8	—30.1	—31.1
Carroll	—35.5	—38.5	—33.2
Bolivar	—38.1	—24.5	—44.4

County, increased by 15.1 percent, has Tupelo, and Forrest County with Hattiesburg increased by 13.2 percent. Most of the counties of large increase also experienced a relatively large increase in nonwhite population.

A large majority of counties showing a large decrease from 1950 to 1958 had experienced a decrease during the decade of the 1940's. No very distinctive pattern other than the fact of population loss characterizes these counties. Some are Delta counties, some are not. Some are relatively large and some are small. Some contain a city and some not. In some the white population increased while the nonwhite decreased, but in many cases whites and nonwhites alike decreased.

Among the counties ranging from moderate increase to moderate loss there is an apparent absence of distinctive characteristics from the population data alone.

Urban Areas Grow

In 1950 there were 15 cities of 10,000 or more people in Mississippi. The 14 counties in which these cities are located showed a total increase in population from 1950 to 1958 of 126,000, 97 percent of which represented an increase of white population. However, 6 of these counties lost in population and three counties, Harrison, Hinds and Jackson, accounted for most of the population gains. Counties with large urban centers gained or lost population as follows:

County	City	Population change 1950-58
Adams	Natchez	744
Coahoma	Clarksdale	—9.361
Forrest	Hattiesburg	5,945
Harrison	Biloxi; Gulfport	80,927
Hinds	Jackson	33,836
Jackson	Pascagoula	27,599
Jones	Laurel	8,765
Lauderdale	Meridian	—5,17
Lee	Tupelo	5,763
Leflore	Greenwood	—11,813
Lowndes	Columbus	3,14
Pike	McComb	—4,137
Warren	Vicksburg	—2,610
Washington	Greenville	—7,50

SOME IMPLICATIONS

From the trends and patterns in Mississippi's population growth, at least three things are extremely important.

First, the chief areas of population growth are those in which urban-industrial development is greatest. For the future this means further urbanization and industrialization are essential if Mississippi's population is to increase. Urban-industrial development will also result in a redistribution of people within the state, with more and more people moving into urban areas.

Second, present birth and death rates must be maintained to offset migration losses. Urbanization is likely to reduce the number of births. Therefore urban development must also serve as a drawing force to prevent out-migration and to bring more people into the state. To maintain a stable population size, opportunities for non-farm employment must be provided for those whose labor is no longer required in agriculture. Alternative to urban-industrial growth is continued heavy out-migration or an ever-growing number of underemployed people in the state.

Third, population losses have been heaviest among nonwhites and in the more rural areas of the state. For the sake of maintaining a stable population size, or possibly a growing population, the white population must increase at least enough to offset the loss of nonwhites.

Appendix Table 1. Population of Mississippi counties, 1940, 1950, and estimates for 1957 and 1958.

County	1958	1957	1950	1940
State of Mississippi	2,184,000	2,164,700	2,178,914	2,183,796
Adams	33,000	32,000	32,256	27,238
Alcorn	27,000	27,000	27,158	26,969
Amite	20,000	17,000	19,261	21,892
Attala	20,000	20,000	26,652	30,227
Benton	11,000	9,100	8,793	10,429
Bolivar	39,000	44,000	63,004	67,574
Calhoun	17,000	19,000	18,369	20,893
Carroll	10,000	12,000	15,499	20,651
Chickasaw	17,000	16,000	18,951	21,427
Choctaw	11,000	9,100	11,009	13,548
Claiborne	10,000	12,000	11,944	12,810
Clarke	16,000	16,000	19,362	20,596
Clay	18,000	17,000	17,757	19,030
Coahoma	40,000	42,000	49,361	48,333
Copiah	28,000	28,000	30,493	33,974
Covington	18,000	17,000	16,036	17,030
DeSoto	23,000	22,000	24,599	26,663
Forrest	51,000	50,000	45,055	34,901
Franklin	8,600	9,100	10,929	12,504
George	16,000	15,000	10,012	8,704
Greene	7,800	8,100	8,215	9,512
Grenada	17,000	16,000	18,830	19,052
Hancock	12,000	12,000	11,891	11,328
Harrison	165,000	165,000	84,073	50,799
Hinds	176,000	167,000	142,164	107,273
Holmes	24,000	25,000	33,301	39,710
Humphreys	16,000	18,000	23,115	26,257
Issaquena	3,700	4,000	4,966	6,433
Itawamba	21,000	21,000	17,216	19,922
Jackson	59,000	57,000	31,401	20,601
Jasper	17,000	16,000	18,912	19,484
Jefferson	10,000	12,000	11,306	13,969
Jefferson Davis	17,000	16,000	15,500	15,869
Jones	66,000	63,000	57,235	49,227
Kemper	12,000	12,000	15,893	21,867
Lafayette	28,000	25,000	22,798	21,257
Lamar	19,000	18,000	13,225	12,096
Lauderdale	59,000	58,000	64,171	58,247
Lawrence	12,000	11,000	12,639	13,983
Leake	22,000	18,000	21,610	24,570
Lee	44,000	46,000	38,237	38,838
Leflore	40,000	40,000	51,813	53,406
Lincoln	24,000	25,000	27,899	27,506
Lowndes	41,000	38,000	37,852	35,245
Madison	25,000	26,000	33,860	37,504
Marion	26,000	27,000	23,967	24,085
Marshall	23,000	23,000	25,106	25,522
Monroe	30,000	33,000	36,543	37,648
Montgomery	14,000	13,000	14,470	15,703
Neshoba	25,000	26,000	25,730	27,882
Newton	18,000	19,000	22,681	24,249
Noxubee	14,000	14,000	20,022	25,669
Oktibbeha	27,000	27,000	24,569	22,151
Panola	29,000	26,000	31,271	34,421
Pearl River	28,000	30,000	20,641	19,125
Perry	7,700	7,700	9,108	9,292

(Continued on page 10)

Appendix Table 2. White population of Mississippi counties, 1940, 1950 and estimates for 1957 and 1958.

County	1958	1957	1950	1940
State of Mississippi	1,256,500	1,263,900	1,188,429	1,106,327
Adams	20,000	19,000	16,153	10,344
Alcorn	21,000	21,000	23,254	22,246
Amite	8,100	7,500	8,823	10,333
Attala	11,500	12,000	15,084	16,848
Benton	5,400	4,100	4,943	5,919
Bolivar	15,000	15,000	19,868	18,070
Calhoun	11,000	13,500	14,080	16,319
Carroll	4,100	5,700	6,663	8,836
Chickasaw	8,100	8,900	10,525	11,410
Choctaw	7,500	6,000	7,680	9,657
Claiborne	3,100	3,000	3,010	3,411
Clarke	9,700	9,500	11,479	12,320
Clay	10,000	8,800	7,660	7,496
Coahoma	15,000	14,000	13,702	10,991
Copiah	14,000	13,000	14,209	16,107
Covington	10,500	10,000	10,823	11,743
DeSoto	9,500	6,600	8,077	7,211
Forrest	35,000	35,000	32,090	23,963
Franklin	4,800	6,200	6,625	7,523
George	14,000	13,000	8,781	7,461
Greene	6,100	6,400	6,711	7,528
Grenada	8,100	7,100	9,001	7,934
Hancock	9,200	9,700	9,852	8,955
Harrison	133,000	136,000	70,652	40,742
Hinds	107,000	100,000	78,247	51,826
Holmes	6,800	6,700	8,824	9,209
Humphreys	4,900	5,800	7,013	6,958
Issaquena	1,800	1,900	1,617	1,228
Itawamba	19,900	20,000	16,279	18,869
Jackson	40,500	41,000	24,664	16,214
Jasper	9,200	8,700	9,193	9,945
Jefferson	2,800	3,100	2,887	3,206
Jefferson Davis	9,800	8,300	6,890	7,087
Jones	48,000	45,000	42,207	35,061
Kemper	5,300	5,400	6,460	8,665
Lafayette	19,000	17,000	14,709	12,683
Lamar	15,500	14,000	11,119	10,006
Lauderdale	37,000	35,000	40,795	35,435
Lawrence	8,400	7,500	7,881	8,762
Leake	13,000	9,600	12,446	14,569
Lee	32,000	33,000	27,578	26,622
Leflore	13,000	14,000	16,482	14,394
Lincoln	16,000	16,500	18,714	17,833
Lowndes	23,000	23,000	19,442	15,562
Madison	6,000	7,800	8,926	8,787
Marion	16,000	17,000	15,575	15,161
Marshall	6,400	6,700	7,374	7,556
Monroe	18,000	19,000	22,829	21,528
Montgomery	7,600	7,400	8,246	8,945
Neshoba	16,400	17,500	19,064	20,881
Newton	12,000	13,000	14,829	15,538
Noxubee	5,500	5,600	5,117	5,640
Oktibbeha	15,000	15,000	12,616	9,063
Panola	13,000	12,000	13,782	13,876
Pearl River	20,000	22,000	16,148	14,973

(Continued on page 10)

Appendix Table 1. (Continued) Population trend of counties . . .

Pike	31,000	29,000	35,137	35,002
Pontotoc	21,000	22,000	19,994	22,904
Prentiss	19,000	18,000	19,810	20,921
Quitman	19,000	21,000	25,885	27,191
Scott	20,000	18,000	21,681	23,144
Rankin	36,000	38,000	28,881	27,934
Sharkey	9,200	9,600	12,903	15,433
Simpson	24,000	22,000	21,819	22,024
Smith	15,000	17,000	16,740	19,403
Stone	6,000	7,000	6,264	6,155
Sunflower	43,000	45,000	56,031	61,007
Tallahatchie	22,000	23,000	30,486	34,166
Tate	17,000	17,000	18,011	19,309
Tippah	17,000	18,000	17,522	19,680
Tishomingo	17,000	15,000	15,544	16,974
Tunica	16,000	17,000	21,664	22,610
Union	24,000	24,000	20,262	21,867
Walthall	15,000	14,000	15,563	17,534
Warren	37,000	35,000	39,616	39,595
Washington	63,000	59,000	70,504	67,576
Wayne	16,000	15,000	17,010	16,928
Webster	13,000	12,000	11,607	14,160
Wilkinson	10,000	11,000	14,116	15,955
Winston	20,000	20,000	22,231	22,751
Yalobusha	13,000	13,000	15,191	18,387
Yazoo	28,000	29,000	35,712	40,091

Appendix Table 2. (Continued) White population of Mississippi . . .

Perry	5,500	5,200	6,897	6,869
Pike	18,000	16,000	19,428	19,291
Pontotoc	16,000	16,500	16,178	18,229
Prentiss	16,000	14,000	17,477	18,522
Quitman	6,700	7,600	10,183	9,120
Rankin	22,000	27,000	15,210	13,260
Scott	12,000	10,000	12,310	13,251
Sharkey	3,000	4,800	3,707	4,317
Simpson	16,000	12,000	14,549	14,935
Smith	10,500	12,000	13,350	15,723
Stone	4,500	5,400	4,899	4,562
Sunflower	16,000	16,000	17,872	17,465
Tallahatchie	9,000	10,000	11,078	11,676
Tate	9,000	7,700	7,640	7,741
Tippah	12,500	12,500	14,129	16,244
Tishomingo	16,500	14,500	14,738	15,949
Tunica	2,000	3,100	3,939	3,265
Union	19,000	19,000	16,626	17,585
Walthall	9,000	8,500	8,397	9,372
Warren	19,000	18,000	19,524	17,310
Washington	26,000	23,000	23,436	18,568
Wayne	10,000	8,000	10,792	11,156
Webster	10,000	9,000	8,915	10,612
Wilkinson	3,000	3,200	4,358	4,511
Winston	11,000	12,000	12,938	13,638
Yalobusha	7,000	7,400	8,529	9,872
Yazoo	11,000	12,000	13,632	13,832

Appendix Table 3. Non-White population of Mississippi counties, 1940, 1950 and estimates for 1957 and 1958.

County	1958	1957	1950	1940
State of Mississippi	901,300	900,800	990,485	1,077,469
Adams	13,000	13,000	16,103	16,894
Alcorn	6,000	6,000	3,904	4,723
Amite	11,900	9,500	10,438	11,559
Attala	8,500	8,000	11,568	13,379
Benton	5,600	5,000	3,850	4,510
Bolivar	24,000	29,000	43,136	49,504
Calhoun	6,000	5,500	4,289	4,574
Carroll	5,900	6,300	8,836	11,815
Chickasaw	8,900	7,100	8,426	10,017
Choctaw	3,500	3,100	3,329	3,891
Claiborne	6,900	9,000	8,934	9,399
Clarke	6,300	6,500	7,883	8,276
Clay	8,000	8,200	10,097	11,534
Coahoma	25,000	28,000	35,659	37,342
Copiah	14,000	15,000	16,284	17,867
Covington	7,500	7,000	5,213	5,287
DeSoto	13,500	15,400	16,522	19,452
Forrest	16,000	15,000	12,965	10,938
Franklin	3,800	2,900	4,304	4,981
George	2,000	2,000	1,231	1,240
Greene	1,700	1,700	1,504	1,984
Grenada	8,900	8,900	9,829	11,118
Hancock	2,800	2,300	2,039	2,373
Harrison	32,000	29,000	13,421	10,057
Hinds	69,000	67,000	63,917	55,447
Holmes	17,200	18,300	24,477	30,501
Humphreys	11,100	12,200	16,102	19,299
Issaquena	1,900	2,100	3,349	5,205
Itawamba	1,100	1,000	937	1,053
Jackson	18,500	16,000	6,737	4,387
Jasper	7,800	7,300	9,719	9,539
Jefferson	7,200	8,900	8,419	10,763
Jefferson Davis	7,200	7,700	8,610	8,782
Jones	18,000	18,000	15,028	14,166
Kemper	6,700	6,600	9,433	13,202
Lafayette	9,000	8,000	8,089	8,574
Lamar	3,500	4,000	2,106	2,095
Lauderdale	22,000	23,000	23,376	22,812
Lawrence	3,600	3,500	4,758	5,221
Leake	9,000	8,400	9,164	10,001
Lee	12,000	13,000	10,659	12,216
Leflore	27,000	26,000	35,331	39,012
Lincoln	8,000	8,500	9,185	9,673
Lowndes	18,000	15,000	18,410	19,683
Madison	19,000	18,200	24,934	28,717
Marion	10,000	10,000	8,392	8,924
Marshall	16,600	16,300	17,732	17,966
Monroe	12,000	14,000	13,714	16,120
Montgomrey	6,400	5,600	6,224	6,758
Neshoba	8,600	8,500	6,666	7,001
Newton	6,000	6,000	7,852	8,711
Noxubee	8,500	8,400	14,905	20,029
Oktibbeha	12,000	12,000	11,953	13,088
Panola	16,000	14,000	17,489	20,545
Pearl River	8,000	8,000	4,493	4,152

(Continued on page 12)

Appendix Table 3. (Continued) Non-White population of Mississippi . . .

Perry	2,200	2,500	2,211	2,432
Pike	13,000	13,000	15,709	15,711
Pontotoc	5,000	5,500	3,816	4,675
Prentiss	3,000	4,000	2,333	2,399
Quitman	12,300	13,400	15,702	18,071
Rankin	14,000	11,000	13,671	14,674
Scott	8,000	8,000	9,371	9,893
Sharkey	6,200	4,800	9,196	11,116
Simpson	8,000	10,000	7,270	7,089
Smith	4,500	5,000	3,390	3,680
Stone	1,500	1,600	1,365	1,593
Sunflower	27,000	29,000	38,159	43,542
Tallahatchie	13,000	13,000	19,408	22,490
Tate	8,000	9,300	10,371	11,568
Tippah	4,500	5,500	3,393	3,436
Tishomingo	500	500	806	1,025
Tunica	14,000	13,900	17,725	19,345
Union	5,000	5,000	3,636	4.282
Walthall	6,000	5,500	7,166	8,162
Warren	18,000	17,000	20,092	22,285
Washington	37,000	36,000	47,068	49,008
Wayne	6,000	7,000	6,218	5,772
Webster	3,000	3,000	2,692	3,548
Wilkinson	7,000	7,800	9,758	11,444
Winston	9,000	8,000	9,293	9,113
Yalobusha	6,000	5,600	6,662	8,515
Yazoo	17,000	17,000	22,080	26,259

Appendix Table 4. Percentage change in total population of Mississippi counties, 1940-1950, 1950-1957 and 1950-1958.

	Percentage change		
County	1950-1958	1950-1957	1940-1950
State of Mississippi	0.2	— 0.6	— 0.2
Adams	2.3	— 0.8	18.4
Alcorn	— 0.6	— 0.6	0.7
Amite	3.8	—11.7	—12.0
Attala	—25.0	—25.0	—11.8
Benton	25.1	3.5	—15.7
Bolivar	—38.1	—30.2	— 6.8
Calhoun	— 7.5	3.4	—12.1
Carroll	—35.5	—22.6	—24.9
Chickasaw	—10.3	—15.6	—11.6
Choctaw	— 0.1	—17.3	—18.7
Claiborne	—16.3	0.5	— 6.8
Clarke	—17.4	—17.4	— 6.0
Clay	1.4	— 4.3	— 6.7
Coahoma	—19.0	—14.9	2.1
Copiah	— 8.2	— 8.2	—10.2
Covington	12.2	6.0	— 5.8
De Soto	— 6.5	—10.6	— 7.7
Forrest	13.2	11.0	29.1
Franklin	—21.3	—16.7	—12.6
George	59.8	49.8	15.0
Greene	— 5.1	— 1.4	—13.6
Grenada	— 9.7	—15.0	— 1.2
Hancock	0.9	0.9	5.0
Harrison	96.3	96.3	65.5
Hinds	23.8	17.5	32.5
Holmes	—27.9	—24.9	—16.1
Humphreys	—30.8	—22.1	—12.0
Issaquena	—25.5	—19.5	—22.8
Itawamba	22.0	22.0	—13.6
Jackson	87.9	81.5	52.4
Jasper	—10.1	—15.4	— 2.9
Jefferson	—11.6	6.1	—19.1
Jefferson Davis	9.7	3.2	— 2.3
Jones	15.3	10.1	16.3
Kemper	—24.5	—24.5	—27.3
Lafayette	22.8	9.7	7.2
Lamar	43.7	36.1	9.3
Lauderdale	— 8.1	— 9.6	10.2
Lawrence	— 5.1	—13.0	— 9.6
Leake	1.8	—16.7	—12.0
Lee	15.1	20.3	— 1.5
Leflore	—22.8	—22.8	— 3.0
Lincoln	—14.0	—10.4	1.4
Lowndes	8.3	0.4	7.4
Madison	—26.2	23.2	— 9.7
Marion	8.5	12.7	— 0.5
Marshall	— 8.4	— 8.4	— 1.6
Monroe	—17.9	— 9.7	— 2.9
Montgomery	— 3.2	—10.2	— 7.9
Neshoba	— 2.8	1.0	— 7.7
Newton	—20.6	—16.2	— 6.5
Noxubee	—30.1	—30.1	—22.0
Oktibbeha	9.9	9.9	10.9
Panola	— 7.3	—16.9	— 9.2

Pearl River	35.7	45.3	7.9
Perry	—15.5	—15.5	— 2.0
Pike	—11.8	—17.5	0.4
Pontotoc	5.0	10.0	—12.7
Prentiss	— 4.1	— 9.1	— 5.3
Quitman	—26.6	—18.9	— 4.8
Rankin	24.6	31.6	3.4
Scott	— 7.8	—17.0	— 6.3
Sharkey	—28.7	—25.6	—16.4
Simpson	10.0	0.9	— 0.9
Smith	—10.4	1.6	—13.7
Stone	— 4.2	11.7	1.8
Sunflower	—23.3	—19.7	— 8.2
Tallahatchie	—27.8	—24.6	—10.8
Tate	— 5.6	— 5.6	— 6.7
Tippah	— 3.0	2.7	—11.0
Tishomingo	9.4	— 3.5	— 8.4
Tunica	—26.1	—21.5	— 4.2
Union	18.4	18.4	— 7.3
Walthall	— 3.6	—10.0	—11.2
Warren	— 6.6	—11.7	0.1
Washington	—10.6	—16.3	4.3
Wayne	— 5.9	—11.8	0.5
Webster	12.0	3.4	—18.0
Wilkinson	—29.2	—22.1	—11.5
Winston	—10.0	—10.0	— 2.3
Yalobusha	—14.4	—14.4	—17.4
Yazoo	—21.6	—18.8	—10.9

Appendix Table 5. Percentage change in white population of Mississippi counties, 1940-1950. 1950-1957 and 1950-1958.

	Percentage change		
County	1950-1958	1950-1957	1940-1950
State of Mississippi	5.7	6.4	7.4
Adams	23.8	17.6	56.2
Alcorn	— 9.7	— 9.7	4.5
Amite	— 8.2	—15.0	—14.6
Attala	—23.8	—20.4	—10.5
Benton	2.9	—17.1	—16.5
Bolivar	—24.5	—24.5	10.0
Calhoun	—21.9	— 4.1	—13.7
Carroll	—38.5	—14.5	—24.6
Chickasaw	—23.0	—15.4	— 7.8
Choctaw	— 2.3	—21.9	—20.5
Claiborne	3.0	— 0.3	—11.8
Clarke	—15.5	—17.2	— 6.8
Clay	30.5	14.9	2.2
Coahoma	9.5	2.2	24.7
Copiah	— 1.5	— 8.5	—11.8
Covington	— 3.0	— 7.6	— 7.8
De Soto	17.6	—18.3	12.0
Forrest	9.1	9.1	33.9
Franklin	—27.5	— 6.4	—11.9
George	59.4	48.0	17.6
Greene	— 9.1	— 4.6	—10.9
Grenada	—10.0	—21.1	13.4
Hancock	— 6.6	— 1.5	10.0
Harrison	88.2	92.5	73.4
Hinds	36.7	27.8	51.0
Holmes	—22.9	—24.1	— 4.2
Humphreys	—30.1	—17.3	0.8
Issaquena	11.3	17.5	31.7
Itawamba	22.2	22.9	—13.7
Jackson	64.2	66.2	52.1
Jasper	0.1	— 5.4	— 7.6
Jefferson	— 3.0	7.4	—10.0
Jefferson Davis	42.2	20.5	— 2.8
Jones	13.7	6.6	20.4
Kemper	—18.0	—16.4	—25.4
Lafayette	29.2	15.6	16.0
Lamar	39.4	25.9	11.1
Lauderdale	— 9.3	—14.2	15.1
Lawrence	6.6	— 4.8	—10.1
Leake	4.5	—22.9	—14.6
Lee	16.0	19.7	3.6
Leflore	—21.1	—15.1	14.5
Lincoln	—14.5	—11.8	4.9
Lowndes	18.3	18.3	24.9
Madison	—32.8	—12.6	1.6
Marion	2.7	9.1	2.7
Marshall	—13.2	— 9.1	— 2.4
Monroe	—21.2	—16.8	6.0
Montgomery	— 7.8	—10.3	— 7.8
Neshoba	—14.0	— 8.2	— 8.7
Newton	—19.1	—12.3	— 4.6
Noxubee	7.5	9.4	— 9.3
Oktibbeha	18.9	18.9	39.2
Panola	— 5.7	—12.9	— 0.7
Pearl River	23.9	36.2	7.8
Perry	—20.3	—24.6	0.4
Pike	— 7.4	—17.6	0.7
Pontotoc	— 1.1	2.0	—11.3
Prentiss	— 8.5	—19.9	— 5.6
Quitman	—34.2	—25.4	11.7
Rankin	44.6	77.5	14.7
Scott	— 2.5	—18.8	— 7.1
Sharkey	—19.1	29.5	—14.1
Simpson	10.0	—17.5	— 2.6
Smith	—21.3	—10.1	—15.1
Stone	— 8.1	10.2	7.4
Sunflower	—10.5	—10.5	2.3
Tallahatchie	—18.8	— 9.7	— 5.1
Tate	17.8	0.8	— 1.3
Tippah	—11.5	—11.5	—13.0
Tishomingo	12.0	— 1.6	— 7.6
Tunica	—49.2	—21.3	20.6
Union	14.3	14.3	— 5.5
Walthall	7.2	1.2	— 9.9
Warren	— 2.7	— 7.8	12.8
Washington	10.9	— 1.9	26.2
Wayne	— 7.3	—25.9	— 3.3
Webster	12.2	1.0	—16.0
Wilkinson	—31.2	—26.6	— 3.4
Winston	—15.0	— 7.2	— 5.1
Yalobusha	—17.9	—13.2	—13.6
Yazoo	—19.3	—12.0	— 1.4

Appendix Table 6. Percentage change in non-white population of Mississippi counties, 1940-1950, 1950-1957 and 1950-1958.

	Percentage change		
County	1950-1958	1950-1957	1940-1950
State of Mississippi	— 9.0	— 9.1	— 8.1
Adams	—19.3	—19.3	— 4.7
Alcorn	53.7	53.7	—17.3
Amite	14.0	— 9.0	— 9.7
Attala	—26.5	—30.8	—13.5
Benton	45.5	29.9	—14.6
Bolivar	—44.4	—32.8	—12.9
Calhoun	39.8	28.2	— 6.2
Carroll	—33.2	—28.7	—25.2
Chickasaw	5.6	—15.7	—15.9
Choctaw	5.1	— 6.9	—14.4
Claiborne	22.8	0.7	— 4.9
Clarke	—20.1	—17.5	— 4.7
Clay	—20.8	—18.8	—12.5
Coahoma	—29.9	—21.5	— 4.5
Copiah	—14.0	— 7.9	— 8.9
Covington	43.9	34.3	— 1.4
De Soto	—18.3	— 6.8	—15.1
Forrest	23.4	15.7	18.5
Franklin	—11.7	—32.6	—13.6
George	62.5	62.5	— 0.7
Greene	13.0	13.0	—24.2
Grenada	— 9.5	— 9.5	—11.6
Hancock	37.3	12.8	—14.1
Harrison	138.4	116.1	33.4
Hinds	8.0	4.8	15.3
Holmes	—29.7	—25.2	—19.8
Humphreys	—31.1	—24.2	—16.6
Issaquena	—43.3	—37.3	—35.7
Itawamba	17.4	6.7	—11.0
Jackson	174.6	137.5	53.6
Jasper	—19.7	—24.9	1.9
Jefferson	—14.5	5.7	—21.8
Jefferson Davis	—16.4	—10.6	— 2.0
Jones	19.8	19.8	6.1
Kemper	—29.0	—30.0	—28.5
Lafayette	11.3	— 1.0	— 5.7
Lamar	66.2	89.9	0.5
Lauderdale	— 5.9	— 1.6	2.5
Lawrence	—24.3	—26.4	— 8.9
Leake	— 1.8	— 8.3	— 8.4
Lee	12.6	22.0	—12.7
Leflore	—23.6	—26.4	— 9.4
Lincoln	—12.9	— 7.5	— 5.0
Lowndes	— 2.2	—18.5	— 6.5
Madison	—23.8	—27.0	—13.2
Marion	19.2	19.2	— 6.0
Marshall	— 6.4	— 8.1	— 1.3
Monroe	—12.5	2.1	—14.9
Montgomery	2.8	—10.0	— 7.9
Neshoba	29.0	27.5	— 4.8
Newton	—23.6	—23.6	— 9.9
Noxubee	—43.0	—43.6	—25.6
Oktibbeha	0.4	0.4	— 8.7
Panola	— 8.5	—19.9	—14.9
Pearl River	78.1	78.1	8.2
Perry	— 0.5	13.1	— 8.7
Pike	—17.2	—17.2	— 0.01
Pontotoc	31.0	44.1	—18.4
Pentiss	28.6	71.5	— 2.8
Quitman	—21.7	—14.7	—13.1
Rankin	2.4	—19.5	— 6.8
Scott	—14.6	—14.6	— 5.3
Sharkey	—32.6	—47.8	—17.3
Simpson	10.0	37.6	2.6
Smith	32.7	47.5	— 7.9
Stone	9.9	17.2	—14.3
Sunflower	—29.2	—24.0	—12.4
Tallahatchie	—33.0	—33.0	—13.7
Tate	—22.9	—10.3	—10.3
Tippah	32.6	62.1	— 1.3
Tishomingo	—38.0	—38.0	—21.4
Tunica	—21.0	—21.6	— 8.4
Union	37.5	37.5	—15.1
Walthall	—16.3	—23.2	—12.2
Warren	—10.4	—15.4	—10.1
Washington	—21.4	—23.5	— 4.0
Wayne	— 3.5	12.6	7.7
Webster	11.4	11.4	—24.1
Wilkinson	—28.3	—20.1	—14.7
Winston	— 3.3	—13.9	2.0
Yalobusha	— 9.9	—15.9	—21.8
Yazoo	—23.0	—23.0	—15.9

BULLETIN 578 JUNE 1959

An Evalution Of
Three Generations Of
Certified Cotton Seed

MITCHELL MEMORIAL [illegible]
AUG 20 1959
MISSISSIPPI [illegible]

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

CONCLUSIONS

Registered, first year, and second year seed of several cotton varieties tested at three locations during three years did not show any differences in yield or staple length which could not be attributed to chance.

The very slight decrease in lint percentage with later generations was statistically significant although it was not great enough to assume considerable economic importance.

The slight increase in yarn strength in the later generations could have been real but probably would have been averaged out with more replication.

The results presented indicate that a well bred cotton variety can be used two or three years from the breeder without loss in acre value if it is handled under an adequate system of seed certification. On the other hand, it cannot be assumed that a variety can be continued indefinitely without the benefit of an efficient maintenance program.

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AN EVALUATION OF THREE GENERATIONS OF CERTIFIED COTTON SEED

By J. F. O'KELLY and S. P. CROCKETT

That well bred cotton varieties do not deteriorate rapidly per se, during four or five years use if there is no outcrossing or mechanical mixing is becoming more generally accepted.

It is a fact, however, that many cotton growers and some farmer advisers still believe that seed directly from the breeder will produce more cotton of a better quality than seed one or more years removed. This belief had its origin at a time when there was much intra- as well as inter-varietal variation, gin mixing of seed was almost universal, and when outcrossing was more extensive than at present.

It is a fact, also, that there probably has not been a commercial variety released which could be classed as homozygous (pure line) in all characters. Moreover, there are sound reasons why homozygosity in all characters is both impractical and unnecessary, even if not undesirable. If then, what are known as pure varieties are, in fact, "pure mixtures," it follows that the system of varietal maintenance practiced by the breeder could, over a period of time, change the variety, even if only slightly, in one or more respects.

Simpson and Duncan (7) produced four generations of seed from each of four varieties. They were thus able to compare five generations of stocks which not only had no mixing nor outcrossing but which also had not been subjected to changes which the breeder might have made, consciously or otherwise, in his maintenance program. They found no differences in most characters measured.

Raskopf (6) made a survey in an area where a high lint percentage variety was predominant. He found a decreasing lint percentage in seed one and two years from the breeder. This he attributed to mixing with lower percentage varieties. Moore and Stutts (5) tested material one, two, and three years from the breeder and which had acquired an unknown degree of mixing. The lint from the later generations became shorter, presumably due to mixture with shorter varieties.

The trials reported here were conducted to determine how varieties behave in an exacting system of seed certification and to help evaluate the several generations of certified seed. In a program of this kind any differences among the generations could theoretically be due to (a) Changes due to the point of emphasis in the breeder's maintenance program: (b) Genetic drift; and (c) Mutations.

Materials and Methods

Registered seed were obtained from the breeder of the variety. First year (blue tag) certified and second year (green tag) certified seed were obtained from Mississippi growers of certified seed. Seed of all three generations were produced under the rather exacting requirements of the Mississippi Seed Improvement Association.

The varieties, Deltapine 15 and Empire, were used in 1952 and 1953. Fox was added in 1954 and 1955 but some lots of seed showed weak emergence and variable stands later, and the yield data from the 1954 and 1955 tests could not be used. Some fiber and spinning data were collected on the 1954 and 1955 material, however, and have been used in the tabulations. It was not possible to purchase second year seed for 1956 testing and special arrangements were made for producing second year seed of Coker Wilt, Delfos 9169, Deltapine 15, and Fox for the 1957 trials.

Mr. O'Kelly, now retired, was agronomist at Mississippi State University. Mr. Crockett is superintendent of the North Mississippi Branch Station at Holly Springs.

The field trials were conducted at three locations. One at State College was on Verona fine sandy loam. A second at State College was on Houlka sandy loam, and the third at the North Mississippi Branch Experiment Station was on Grenada silt loam. These are referred to in the tables and elsewhere as locations 1, 2, and 3, respectively. All tests consisted of six randomized replications of single row plots varying in length from 70' to 100' with a row width of 40 inches.

These field trials were handled about as in normal cotton production. They were planted in late April or early May. The fertilizer used was at or near the normally recommended kind and rate. Insect control was fair to good. Stands were uniform in all tests except those in 1954 and 1955 which were used only for obtaining certain fiber data.

Lint percentages from all tests at locations 1 and 2 and at location 3 in 1957 were obtained by ginning three 10-pound composite samples from each test. Samples for spinning were drawn from these 10-pound ginnings. In 1952 and 1953 lint percentages at location 3 were based on the ginning of three 100-boll samples. In all tests the 100-boll samples were also used to provide fiber for obtaining data on boll size, staple length and other fiber properties.

The upper half mean and some other fiber data were provided by the University of Tennessee Fiber Research Laboratory, Knoxville, Tennessee. The spinning data for location 3, 1957 were provided by the Spinning Laboratory, U. S. Cotton Field Station, Knoxville, Tenn., while all other spinning data were supplied by the U. S. D. A. Cotton Spinning Laboratory, College Station, Texas.

Results and Discussion

The yields in pounds of lint cotton per acre for all tests are given in Table 1. In order to facilitate grouping these data by variety the statistical evaluation data are given separately in Table 2. This table should be consulted while studying table 1 and the statements which follow.

It will be noted from table 1 that there is no downward trend for generations in the grand average. This is an average of 144 replications for each seed generation. There is some variation among the variety averages and also among the generations. It will be found, however, that trends in one direction are often offset by trends in the opposite direction, sometimes in the same variety at another location in the same year. At location 2, 1953,, the difference in generations was significant at the 5% level. This did not occur at any other location nor in any other year and must be attributed to chance.

Since the potential yield differences of cotton varieties are affected very markedly by numerous environmental factors, it appears safe to conclude that the differences found do not indicate a lower yield potential for the later generation seed.

The data given in Table 3 indicate there was a very slight downward trend in lint percentage in later generations. This appeared to be true in four of the five varieties. Since the number of bolls per pound of lint is, in part, a function of lint percentage, it follows that the lower the lint percentage, the greater the number of bolls per pound. In three of the four cases cited the number of bolls per pound of lint did show an increase. Also the one variety showing a slightly increasing lint percentage showed a decrease in the number of bolls per pound. These changes are not great enough to assume agronomic importance but that some of them are real is indicated by the statistical data presented in Table 4. The lint percentage differences found at all locations in 1957 were significant or highly significant for generations and for varieties X generations.

Table 1. Pounds lint cotton per acre by year, location, generation and variety.

Year	Location	Registered	Generation 1st year	 2nd year
		Deltapine 15		
1952	1	475.9	497.9	535.2
"	2	531.7	538.6	521.8
"	3	468.3	462.6	456.7
1953	1	693.3	668.4	714.5
"	2	653.0	702.2	622.9
"	3	444.6	431.0	449.6
1957	1	508.7	487.4	500.5
"	2	458.2	493.4	441.8
"	3	462.1	514.1	543.5
Variety average		521.8	532.8	531.8
		Empire		
1952	1	579.3	547.7	550.0
"	2	522.0	529.2	522.4
"	3	394.2	366.2	409.9
1953	1	701.2	738.0	727.7
"	2	717.2	700.9	672.5
"	3	490.5	497.0	487.8
Variety average		567.4	563.2	561.7
		Fox		
1957	1	538.9	496.7	439.6
"	2	452.9	472.7	476.3
"	3	488.0	535.0	572.4
Variety average		493.3	501.5	496.1
		Coker Wilt		
1957	1	412.5	455.7	497.3
"	2	490.6	480.4	467.2
"	3	622.8	470.9	541.5
Variety average		508.6	469.0	502.0
		Delfos 9169		
1957	1	472.0	501.5	468.0
"	2	458.6	453.3	436.8
"	3	614.6	683.3	573.9
Variety average		515.1	546.0	492.9
Grand average*		527.1	530.2	526.2

*Each of these averages is an average of 144 field plot replications.

Table 2. Statistical evaluation of yield data in table 1.

Year	Location	Significance Varieties	 Generations	Coeff. of variation
1952	1	**	N S	8.7
"	2	**	N S	8.1
"	3	**	N S	13.8
1953	1	**	N S	10.7
"	2	**	*	6.6
"	3	**	N S	12.1
1957	1	*	N S	10.0
"	2	N S	N S	10.6
"	3	**	N S	13.5

*Significant at 5%.
**Significant at 1%.

In this connection it is interesting to note that Simpson and Duncan (7) compared five generations of four varieties and in three of the varieties found significant changes in lint index and seed index. Some of the factors which affect these indices also affect lint percentage. No significant change in lint percentage was observed, however, in their study.

Theoretically, if contrasting genes are present in a seed stock in certain proportions, the proportion should not change over a considerable period unless conditions are favorable for the increase of the one over the other. It is reasonable to suppose that a differential in reproduction or survival or both might occur.

For example, if seed of two cotton varieties having the same potential lint yield but the one having genes for high lint percentage and the other genes for low lint percentage were mixed in equal proportions and planted, the plants bearing genes for low lint percentage should produce the most seed. In subsequent generations there should be a genetic drift toward a lower lint percentage.

The genes of deleterious segregates and mutants would normally be eliminated or held to a low level unless some environmental or other condition favored the survival and fruit setting of plants carrying such genes. A case in point is the "Hindi" off-type plants with which Egyptian plant breeders have had to contend. In regard to the recurrence and increase of such plants Brown (1) says: "If there is a heterosis effect, which is

Table 3. Lint percentage and bolls per pound lint for varieties and generations.

Variety	Generation		
	Reg.	1st year	2nd year
	Lint percentage		
Deltapine 15	40.3	40.1	39.9
Empire	38.0	38.0	37.9
Fox	37.0	37.7	37.1
Coker Wilt	38.2	37.6	37.6
Delfos 9169	36.7	36.7	36.2
All varieties	38.6	38.5	38.3
	Bolls per pound lint		
Deltapine 15	198	203	200
Empire	165	171	172
Fox	207	203	199
Coker Wilt	191	194	192
Delfos 9169	186	180	179
All varieties	189	191	189

*The data for varieties are averages for all tests for the three years.

Table 4. Statistical evaluation of lint percentage data in table 3.

Year	Location	Significance		
		Generation	Varieties X generations	Coeff. of variation
1952	1	N S	N S	12.0
”	2	N S	N S	6.7
”	3	N S	N S	12.3
1953	1	*	N S	8.5
”	2	N S	N S	7.7
”	3	N S	N S	16.8
1957	1	*	**	10.9
”	2	**	**	8.5
”	3	**	**	11.0

*Significant at 5%.

**Significant at 1%.

obvious enough with Hindi hybrids and may occur to a lesser extent with intervarietal hybrids, it is clear that there could be a sharp increase in the percentage of these hybrids after thinning. No peasant would dream of thinning out his best seedlings."

Hybrid vigor will seldom be a problem in commercial cotton varieties as they are now being developed and maintained. It is well, however, to keep the phenomenon in mind in any longtime maintenance program. The author has often selected excellent individual plants which, in later generations, proved to have been hybrids.

Loden and Richmond (4) have provided a rather complete report of work on hybrid vigor prior to 1951. Christidis (2), Harris and Loden (3), and Turner (8) have, among others, made contributions since that date.

The staple lengths as determined by the cotton classer and the upper half mean as measured on the fibrograph, Table 5, did not show any differences of consequence in the overall averages. It is not surprising that the upper half mean data show so little variation. The breeding stocks used in the development of varieties during the past two decades have, for the most part, carried genes for medium length staple.

The points in the foregoing discussion form the basis for the senior author's opinion that, although a cotton variety may not deteriorate appreciably in two or three years, its use over an indefinite period without an adequate maintenance program can lead to unwanted changes.

Since there were no wide generation differences in fiber strength and fineness (data not presented) nor in staple length (Table 5), it was not considered necessary to conduct extensive spinning trials. Some samples were spun, however, and the results are given in Table 6. Only one composite lint sample for spinning was taken from any one generation at a location. For this reason the results among the generations of any variety would be expected to vary considerably.

The greatest yarn strength difference among generations in any variety as shown in Table 6 was in Coker Wilt. In this variety registered seed produced a yarn eight pounds weaker than first year seed. This wide difference may be due to several causes. It could, of course, have been due, in part at least, to normal variation which more replication might have reduced. It could also have been due, in part, to weaker fiber.

Tabe 5. Staple lengths by variety and generations.*

Variety	Registered	Generation 1st year	 2nd year
	Classers length in 32nds inch		
Deltapine 15	32.9	33.3	33.1
Empire	33.2	32.7	32.8
Fox	32.7	33.3	33.0
Coker Wilt	33.7	34.0	34.0
Delfos 9169	33.7	33.7	33.3
All varieties	33.1	33.3	33.2
	Upper half mean in inches		
Deltapine 15	1.05	1.06	1.05
Empire	1.04	1.04	1.02
Fox	1.08	1.08	1.08
Coker Wilt	1.12	1.13	1.13
Delfos 9169	1.14	1.12	1.13
All varieties	1.07	1.07	1.07

*The lengths are averages for all locations and all years.

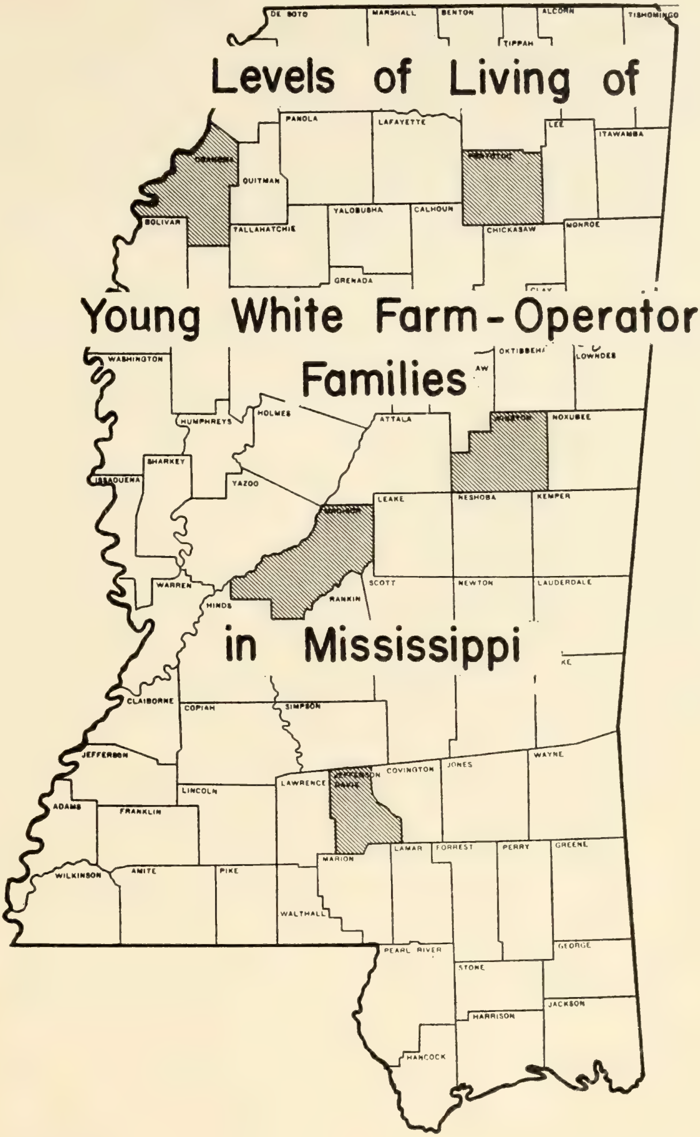
This is supported by the fact that the stelometer readings for registered seed were lower than for first and second year seed and registered seed at location 3 (Table 1) produced considerably more lint than the other two generations. The senior author has unpublished data from a defloration study indicating that the fiber from heavily fruited plants will be weaker than that from plants of the same genetic constitution but having only about half as much fruit.

It may be noted also that an abrupt change like this could occur between the registered and first year generations if the breeder, at intervals, in his maintenance program replaces the parent stock with a single extracted line which may be very similar to the parent stock in all ways except in a characteristics like this. An abrupt change of this proportion could not occur in a maintenance program based on increase from a composite of many extracted progenies.

Table 6. Breakings strengths in pounds of 22's yarn by variety, year, location, and generation.

		Generation		
Year	Location	Registered	1st year	2nd year
Deltapine 15				
1954	1	103.8	103.3	109.4
1954	2	108.2	107.9	109.1
1955	2	124.9	125.2	126.7
1957	3	106.1	109.8	107.9
Variety average		110.8	111.6	113.3
Empire				
1954	1	104.3	103.5	105.0
1954	2	111.2	109.5	109.8
1955	2	121.1	120.7	120.8
Variety average		112.2	111.2	111.9
Fox				
1954	1	103.0	103.8	100.5
1954	2	109.5	110.9	106.9
1955	2	121.3	122.8	121.3
1957	3	110.8	106.3	104.2
Variety average		111.2	111.0	108.2
Coker Wilt				
1957	3	105.2	113.1	114.6
Delfos 9169				
1957	3	99.2	99.7	101.0
Grand average		109.9	110.5	110.6

Levels of Living of Young White Farm-Operator Families in Mississippi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TALLAHATCHIE
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
GRENADA
CLAY
OKTIBBEHA
LOWNDES
WASHINGTON
AW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
SCOTT
NEWTON
LAUDERDALE
HINDS
RANKIN
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CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
JEFFERSON DAVIS
COVINGTON
JONES
WAYNE
LAWRENCE
LINCOLN
ADAMS
FRANKLIN
LAMAR
FORREST
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LEVELS OF LIVING OF YOUNG WHITE FARM-OPERATOR FAMILIES IN MISSISSIPPI[1]

By DOROTHY DICKINS

Department of Home Economics, State College, Miss.

Introduction

In the thirties, during and shortly following the world-wide business depression, two studies were made in Mississippi of the manner of living of farm youths, 17 to 35 years of age.[2] Reports of these studies give detailed data on incomes, expenditures, savings and other aspects of consumption of young farm-operator white families.

Similar information is not available on such families during a period of relative prosperity such as is the present. Since the thirties Mississippi has undergone considerable industrialization. Non-farm jobs are now more available.

It is known that young farm-operator families have problems in family financial management different from older families. Furthermore, it is known that this group will adopt recommendations for improvement more readily than older operator families.

It was the purpose of this study to find out how young farm-operator families live and their problems. Such information will provide a basis for guidance for educational programs and counseling services.

Selection of Families

A soils specialist in the Mississippi Agricultural Experiment Station was consulted for names of counties to represent principal soil types in the State. The following counties were selected: Coahoma, Jefferson Davis, Madison, Pontotoc, and Winston.

At the time this study was started in 1958, population estimates were available from the 1955 agricultural census of the number of white farm-operators in the State by age. According to these estimates only 14 percent of the farm-operators were under 35 years of age. In 1930 about one-third of these operators were under 35 years. In the 1950 census about 22 percent had been in this age group. Fourteen percent of the farm-operators would not have been eligible for this study, however, since only families with both the husband and wife who had kept house during 1957 were to be included in the study. Also, the study was limited to families who operate farms in which value of products sold during the report year was $250 or more. To reduce the expense of obtaining necessary data from families, it was decided to include families in which the operator was under 40 years of age rather than under 35.[3]

County and home demonstration agents in the five counties were asked to select several neighborhoods including both better and poorer farming areas and to list some families who were probably eligible in each of these neighborhoods. Lists were enlarged by the interviewers when they visited the neighborhoods. Farm-operator families visited sometimes knew of other eligible families nearby. Also, suggestions were given by country store owners and other neighborhood leaders. The number of eligible families was quite limited in all five counties. Schedules were completed for 104 families, or approximately 20 in each of the five counties by interview with husband and wife with the use of a schedule.

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[1] This is the first report of a study of young farm-operator families. It is limited to an analysis of data obtained from 104 white families. The second report will give a similar analysis of 100 young farm-operator Negro families.

[2] (a). Occupations of Sons and Daughters of Mississippi Cotton Farmers. Dorothy Dickins. Miss. Agr. Exp. Sta. Bull. 318, May, 1937.

(b). Some Contrasts in Levels of Living of Women Engaged in Farm, Textile Mill and Garment Plant Work. Dorothy Dickins. Miss. Agr. Exp. Sta. Bull. 364, November, 1941.

[3] Four families were included in which the operator was 40 years of age at the time of the interview but in these families the operator had been 39 years most of the report year, 1957.

Description of Families

Husbands (or farm-operators) in 75 of the 104 families were 30 - 39 years of age. This prepondence of the older group seems to check with census data—that fewer and fewer young men in the State are operating farms. Fifty percent of the wives of these operators were 30-39 years of age. Homemakers in two families were older than 39 years, the remaining were under 30 years.

Seventy-five husbands had had G.I. training of one or more kinds. For the majority this G.I. training was farm training. Sixty-four had had farm training. Thirty-two of the 104 families participated in the balanced farm and home planning program of the Agricultural Extension Service. Wives had completed an average of 12 grades in school, husbands an average of 11 grades.

Members of the economic family averaged 4.19 persons. By economic family is meant the members dependent upon family funds for most of their support. Only 9 of the 104 families had no children.

Tenure and Assistance in Getting a Start in Farming

Every family was asked about the main farm tenure or tenure of the major part of the land cultivated during the past year. Main tenure was as follows:

	Percent
Owner	67
Cash renter	13
Share renter	14
Share cropper	1
Manager	3
Use of relative's land*	2

*Relative pays taxes.

Seventy percent of the families owned some farm land. The number of acres owned by those owning averaged 163. The number of acres owned ranged from one acre to 1605 acres. Eighty-one percent of those owning land said they had acquired it by purchase. Eleven percent had inherited and 8 percent had purchased some, inherited some. Twenty-one percent of the renters and share workers were renting or share-working land of relatives.

All families were asked about assistance in the form of money, house-furnishings, farm equipment or livestock they had received before and since marriage from their family or other relatives. Thirteen reported having received such assistance before marriage, nine since marriage. Assistance listed included outright gifts, as well as a few loans. Three families reported use of tractors loaned by relatives, one family reported a loan from his father-in-law of $1,000 without interest. Seventy-four of the 104 families had received no substantial assistance from family or relatives in getting started in farming, either in the form of gifts or loans of land, money, livestock or house-furnishings.

Getting A Living

The net income of the 104 families during 1957, the year preceding the interview, ranged from a high of $23,808 down to a loss of $1,279. It averaged $3,902. By net income is meant the sum of net receipts (1) from farm operation; (2) from off-farm work; (3) from other nonfarm income except non-recurrent income such as inheritances. Net income of the families was distributed as follows:

	Percent
Under $1,000	8*
$1,000 - $1,999	17
$2,000 - $2,999	21
$3,000 - $3,999	20
$4,000 - $4,999	14
$5,000 and over	19

*Two of the 8 families had negative incomes.

The net income of families in the five counties ranged from an average of $2,270 in Pontotoc County to an average of $6,306 in Coahoma County. (See Table 1 in the Appendix). In figuring income

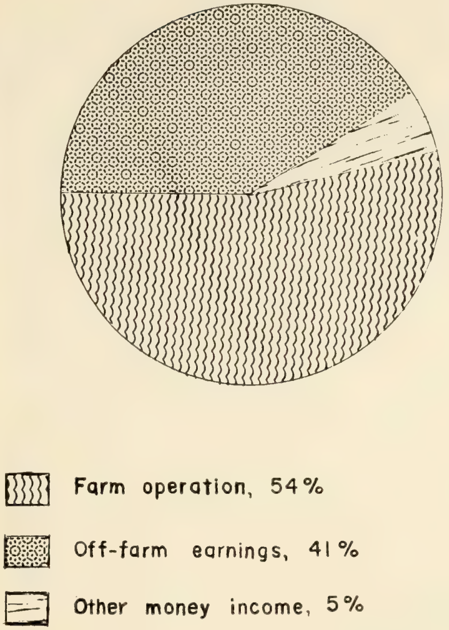

Figure 1. Percentage of net income of 104 young farm-operator families classified by source of income.

no deductions were made for depreciation of buildings and equipment, and no consideration for change in inventories.

Gross income from farm operation averaged $7,826. This average was based on incomes from 101 families. The three families whose husbands managed farms for others are not included in the $7826 average. The farm expenses of the 101 families averaged $5,758 or 73 percent of the gross farm income.

These 101 families netted an average of $2,068 from farm operation. This differed only slightly from the net farm income of the entire group which averaged $2,087. This amount is 54 percent of the total net income (Figure 1).

In all counties included except Coahoma there were balanced home and farm planning programs. Seventeen of the 20 families included in Madison County participated in this program during 1957. Seven of the 23 Winston County families, six of the 21 Jefferson Davis families, and two of the 20 Pontotoc County families likewise participated in this program. It is interesting to note that net from farming was highest in Madison County (See Table 2 in the Appendix) where most of the families included participated in balanced farm and home planning and where sales of livestock and livestock products were greatest.

The families in the farm home planning program grossed from the farm an average of $7793, netted from the farm an average of $3093; those not on the program grossed an average of $7841 and netted an average of $1614.[4] The fact that 1957 was a "bad" year for cotton and that Coahoma County was not a farm home planning county accounts for much of the difference, however.

Seventy-five percent of the net income of families in Madison County and 66 percent of those in Coahoma County was derived from farm operation. The percentage in Pontotoc County was 40, in Winston and Jefferson Davis Counties 26 and 21 respectively.

Homemakers were questioned about farm tasks they did often, sometimes, and never. Sixty percent of the women said they did errands in connection with the farm either often or sometimes, 35 percent reported caring for farm livestock, 32 percent doing field work.

The average amount per family earned from off-farm work by members of the 104 families during 1957 was:

	Income
Husband	$1,050
Wife	535
Other members	22
Total	$1,607

Fifty-six percent of the farm operators and 32 percent of the wives had had earnings from off-farm work during period. The majority of these families, however, (67 percent) had received during the report year, larger amounts from farm products sold than from off-farm earnings. As will be noted, 41 percent of the average total income was derived from off-farm work (Figure 1).

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[4] The three families in which the operator managed a farm are excluded from this comparison.

Fifty percent of the families had "other money income." Other money income included pensions, welfare payments, G.I. payments, net income from business owned but not operated, interest or dividends and the like. The average amount of such income received by the 104 families was $208 or five percent of the total net income (Figure 1).

Manner of Living

The manner of living of a family is best described by the goods and services it uses either purchased or home-produced; its housing and equipment; and the part it plays in the community.

Expenditures for family living of the 104 families included ranged from $802 to $13,713 with an average of $3179. Average expenditures for family living ranged from a low of $2,210 in Pontotoc County to a high of $5,426 in Coahoma County. (See Table 2 in Appendix). In other words expenditures for family living were related to family income. It was the family in Coahoma and Pontotoc Counties, however, who most often showed a net deficit. The Pontotoc County families of this study did not have the off-farm earnings that the Jefferson Davis and Winston County families did. Coahoma County families were for the most part cotton farm families. Excessive rains during 1957 had had an adverse effect on the cotton crop.

Expenditures for family living varied with net family income as follows:

Net income	Average expenditures per family
Under $2,000	$1820
$2,000 - $2,999	2528
$3,000 - $3,999	3012
$4,000 - $4,999	3293
$5,000 and over	5701

Expenses for food during 1957 ranged from $174 to $2,264 and averaged $735, or $184 per family member. Expenditures for food include expenditures for drinks and snacks eaten away from home, for other meals including lunches taken in school lunch rooms, and for vitamins and minerals as well as for food used at home including that in packed lunches eaten away from home (see Table 3 in the Appendix). Money expenditures for food were about one-fourth (23 percent) of the amount spent for family living (Figure 2).

All families in this study produced some food for family consumption. Included as home-produced were foods obtained from woods, fields, streams, such as wild fruit, game, fish, as well as foods actually produced such as milk, tomatoes, eggs, etc. The values of these foods ranged from $9 to $1,515, with an average of $564 (see Table 4 in the Appendix for specified kinds of home-produced foods used).

Families were questioned about the type of food production activities husbands had done during 1957. Sixty-two percent reported husbands cared for hogs often. Other activities which the majority of husbands did often were care of the milk cow (60 percent), and milking (55 percent). Forty-seven percent worked in the garden often, and 44 percent cared for poultry often. Few were reported as doing often activities traditionally done by women, i.e. assistance in canning and preserving (26 percent), gathering vegetables (25 percent), and dressing poultry (15 percent).

The 104 families spent an average of $382 for clothing, clothing services and personal care. This is 12 percent of the total family living expenditures (Figure 2).

Two hundred and sixty-three of the $382 was for clothing. Clothing expenditures ranged from $40 to $805 per family. Expenditures for clothing services averaged $38 and those for personal care, $81. Forty-three dollars of the amount for personal care were spent for services at the beauty parlor and barber shop. The remainder ‘($38) was spent for products used in personal care such as toilet soap, cosmetics and the like. (See Table 3 in Appendix).

The 104 families spent an average of $694 on the house, its operation, furnishings and equipment during 1957. This is 22 percent of the expenditures for family living (Figure 2) and about the same percentage that was spent for food.

Houses in which the families resided had an average of 5.4 rooms. The average number of bedrooms per family was 2.5. Fifty percent of the families lived in houses in which the exterior of the house had been painted in the last 5 years.

Families were classified according to house type.[5] These types were as follows: (1) Six rooms or more in good condition; (2) Six rooms or more in medium condition or 5 rooms in good condition; (3) Six rooms or more in bad condition; (4) Five rooms in medium condition; (5) Four rooms or less in good or medium condition. Four rooms or less in back of store; (6) Five rooms or less in bad condition. Houses of the families included when classified into the six types were distributed as follows:

Housing Type	Percent
1	33
2	26
3	1
4	16
5	20
6	4

Household operation took a little more

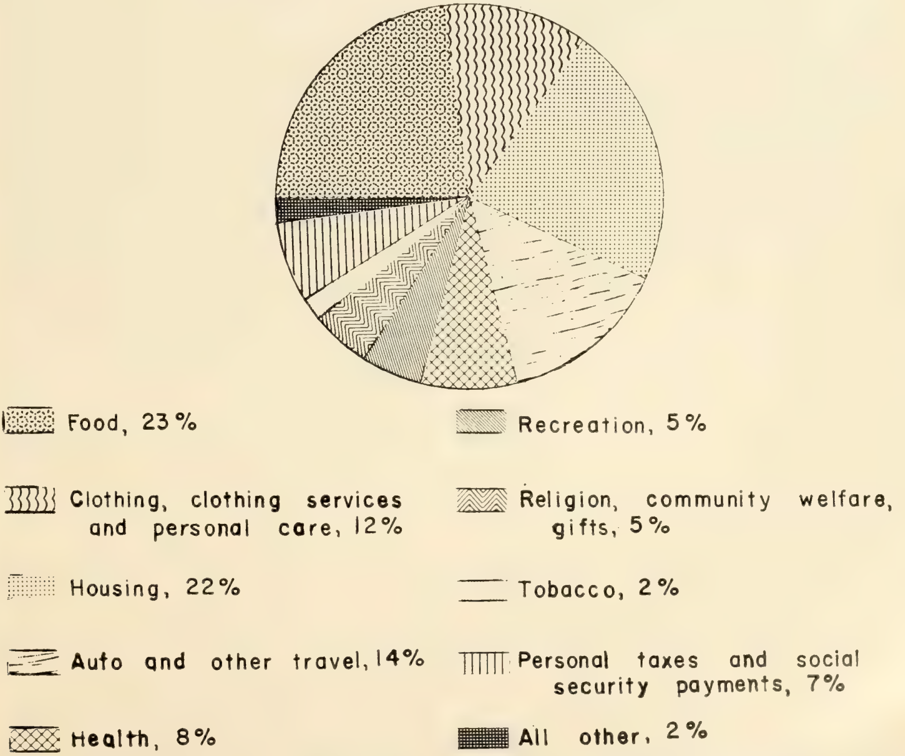

Figure 2. Percentage of total expenditures for family living of 104 young farm-operator families classified by source of expense.

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[5] The housing types and directions for classifying are based on a classification developed by Lloyd Warner. See "Social Class in America" by W. Lloyd Warner, Marchia Meeker and Kenneth Eells. Science Research Associates, Chicago, Illinois, 1949, Ch. 8.

than one-half (62 percent) of the housing dollar of these families. Included under household operation expenses are such things as cost of utilities such as electricity, gas, telephone, cleaning and other supplies, wages for household help, freezing supplies and locker rental, and laundry sent out. All these families had electricity. Eighty-two percent had water piped into the kitchen. Seventy-nine percent had water piped to the bathroom.

The percentage of families having plumbing of specified kinds was:

	Percent
Kitchen sink	77
Lavatory	65
Flush toilet	64
Bath tub	63
Shower	24

Seventy-six percent of the families heated with gas. The usual type of heater was the gas radiant. Forty-five percent of the families obtained some fire and/or stove wood from nearby wooded areas (See Table 4 in the Appendix).

Expenditures for furnishing and equipment ranged from 0 to $1,307 with an average of $171 (See Table 3 in the Appendix). Shown below is the percentage of families owning household equipment of specified kinds:

Equipment	Percent owning
Electric iron	100
Mechanical refrigerator	99
Washing machine (all kinds)	93
Sewing machine (all kinds)	76
Gas cook stove	67
Home freezer	66
Electric fans, movable	63
Pressure cooker	54
Electric sewing machine	50
Pressure sauce pan	46
Window fans	40
Automatic washing machine	39
Own other electrical equipment*	35
Electric cook stove	32
Air conditioner	13
Attic fans	12
Mechanical clothes dryer (all kinds)	8
Rent frozen food locker	7
Automatic clothes dryer	6
Electric dish washing machine	1

*The mixer was most frequently named; the toaster was next in importance.

Families were questioned about nine kinds of homemaking activities possibly performed by husbands during the past year (cooking, food marketing, care of children, upkeep of lawns, washing dishes, washing clothes, hanging out clothes, ironing clothes, general cleaning). Food marketing, care of children and upkeep of lawns were the homemaking activities most often checked as performed often and sometimes during the past year by husbands. Ironing clothes, washing clothes and washing dishes were the activities most frequently checked as not done.

"Auto and other travel" ranked third in expenses for family living of these families (Figure 2). Food took the largest amount, then housing including expenses for the house, household operation and furnishings and equipment.

Average expenditures for the auto were $432 and for other travel $21. (Table 3 in the Appendix). Ninety-nine of the 104 families had an auto and/or truck they used for the family (only the family's share of the use of the auto or truck was regarded as a family expense). Twenty-five percent of the families purchased an auto and/or truck they used for the family during 1957. These autos and/or trucks were for the most part bought second hand. Only 21 percent of the families incurred expenses for other travel (Table 3 in the Appendix).

Average total expenditures for health including medical care and insurance payments was $265 or 8 percent of the total expenditure (Figure 2). One hundred and ninety-five dollars was for medical care; 70 dollars for health policies. Fifty-eight percent carried health policies (See Table 3 in the Appendix). In addition to the $265 spent for health was the average of $20 per family received from insurance companies for illnesses of family members. Twenty-three of the families received these payments averaging about $90 each.

During the report year 18 of the homemakers had lost time from usual activities due to childbirth or causes related to pregnancy. In four families there had been accidents causing loss of time. There had been 52 visits in hospitals by members in the 104 families. Forty-two percent of these families had had someone in the hospital during the report year. This means, in a few cases, a person had been to the hospital more than once or more than one member in a family had been hospitalized during the year.

These 104 families could be classified as healthy families. The health of only one husband and only one wife was rated as poor. The health of 89 percent of the husbands and of 93 percent of the wives was rated as good. Health of the remainder was rated as fair. Seventeen percent of the families said they had a health problem. Six families mentioned children with a health problem—in three of these it was asthma. Four mentioned health problems in connection with parents residing with them and 8 health problems of either husband or wife; such as, hayfever, husband ruptured needs operation, asthma, needs all teeth taken out.

Families in this study spent during 1957 an average of $163 for recreation. Toys for children took the largest amount ($47); then reading material; T.V., radio, and piano; sports equipment. Each one of these three types of things averaged $26 per family (See Table 3 in Appendix).

During the report year 9 families purchased television sets. There were, in addition, two who had purchased antennaes. Two had purchased radios, or radio-phonographs and two a piano.

At the time of the interview the following percentage of families owned musical equipment of specified kinds:

Radio or radio-phonograph	90
Television	83
Record player, phonograph	29
Piano	22

The family was asked about the organizations the husband and wife had attended regularly and occasionally during the past year and whether or not they had held any office or served on a committee in connection with participation in the organization. The average number of organizations attended regularly or occasionally by the husband and wife was:

	Husband	Wife
Religious	1.6	1.8
Agricultural	.4	.4
All other	.5	.3
Total	2.5	2.5

Religious organizations included church, Sunday School, Missionary Society, Young Peoples Union, Brotherhood. Agricultural organizations included home demonstration clubs, community clubs, 4-H clubs, Farm Bureau, Planters club, Dairy Association, Livestock Association. Other organizations included veterans' associations, Mason and Eastern Star, women's civic, men's civic, social, P.T.A., Citizens Council. Average number of offices or committee assignments held by husbands was .5, by wives .7.

Nineteen husbands and 16 wives had attended no organization regularly during the past year. When asked why they had not attended regularly typical replies were "children too young", "no time", "live too far from meetings", "need to rest", "not in habit", "operate a dairy", "no help", "not interested".

Homemakers were asked if they had entertained at meals the past year—relatives, friends, group meetings. Only 4 percent of the families had done no entertaining whatever. Ninety-five percent had entertained relatives, 83 percent had entertained friends. Group meetings had been entertained in the homes of 30 percent. Some of the groups entertained were a Sunday School class, a church circle, a birthday party for children, a bridge club, a home demonstration club.

The 104 families spent an average of $73 for tobacco. Under tobacco was included all types of tobacco, smoking, chewing and snuff, as well as smoking supplies such as ash trays, pipe. Expenditures for tobacco and supplies ranged from none to $438.

Fifty-seven percent of the families had children in school. Expenditures for education including such things as papers, pencils, tuition, special lessons, averaged $20 per family (textbooks are furnished in public schools by the State). Expenditures for education ranged from 0 to $175.

Ninety-seven percent of the families had some expenditures for religion, gifts, and community welfare. These gifts and contributions ranged from 0 to $1400 and averaged $153.

Ninety percent of the families reported expenditures for income, poll and/or other personal taxes. The average amount paid for these taxes was $150 (See Table 3 in the Appendix). Eighty-three percent had made expenditures for social security payments. These payments averaged $66 per family.[6] Forty percent of the farm families paid social security separately as farm operators and the remaining making payments (43 percent) had amounts deducted from off-farm earnings.

Fifty-five percent of the families had other family expenditures such as for charges in connection with checking accounts, safety deposit box rental, birth certificates, notary and lawyer fees, funeral and cemetery expense not covered by insurance. These other expenses averaged $25 per family.

Funds Available Other Than Family Income

Sixty-three percent of the families drew on assets or increased debts to make funds available for family use. The average decrease in these assets and increase in these debts was $1204.

More families used the installment plan and larger amounts were involved than were other forms of credit (Table 1). This type of credit was used for cars, trucks, and tractors as well as for household equipment and furnishings.

These families went in debt or reduced assets for farm expenses much more than for family expenses. A number of farm operators spoke of the expense of modern farming and the great need for help in reducing farming costs.

Disposition of Money Received But Not Used for Current Family Expenditures

All families used some of their income to increase their assets and to decrease debts. The average amount used for this purpose was $1956. Largest amounts were involved in payments on auto, truck or tractors bought more than a year ago (farm share). But more families paid insurance premiums for life and burial insurance (Table 2). Fifty-one percent paid premiums on life insurance.

As stated before, 70 percent of the families owned some farm land and 61 percent of these had made payments on mortgages for farm or farm home during the past year. The average amount paid by those making such payments was $606.

Surpluses and Deficits

Sixty-seven percent of the families had net surpluses; that is, money income exceeded current expenditures during 1957. These surpluses amounted to an average of $1648. More Madison County farm operator families had surpluses and larger surpluses than did families in the other four counties (See Table 2 in Appendix). This fact is no doubt related at least in part to the large number in the Madison County sample who participated in balanced farm and home planning.

Thirty-three percent of the families spent more than their money income and incurred net deficits averaging $1,112. More Coahoma County farm operator families had deficits than did families in the other counties. As stated before, 1957, because of excessive rains, was not a good year for cotton farming.

Taken as a whole the 104 families

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[6] Only income, poll and other personal taxes are included in this section. Other taxes such as excise and sales taxes are merged with goods and services to which they apply. Taxes on business operating and income producing property were deducted in estimating net income. Social security payments are also regarded as taxes. Social security payments include those paid separately as farm operators and amounts deducted from off-farm earnings.

showed a net surplus of $753 (See Table 5 in Appendix).

Goals For The Next Ten Years

Every family in the present study was asked: "Are there things you plan to have in the next ten years that you do not now have?" "If yes, what?" Only three percent of the families replied "No" to this question. Most families named several items. A classification of the replies is given in Table 6 in the Appendix.

In 29 percent of the families the only item or items mentioned related to the house—a new house, a house of my own, plumbing, add a den, add another bedroom, redecorate the house. Twelve percent mentioned plans for both house and farm. Nine percent named one or more kinds of household furnishing and equipment. The same percentage named both basic changes in housing and one or more kinds of household furnishing and equipment. Nine families mentioned only plans for the farm.

Income and Family Living Now and in the Late Thirties

The present situation is quite different from the situation in the State in 1934. At that time information was obtained from 500 representative farm families with one or more children 19-34 years of age concerning occupations of these sons and daughters.[7] Information was obtained concerning a total of 799 sons and 768 daughters. Three-fourths of this group were farming or were dependent at least in part upon the farm for livelihood. Two-thirds were entirely dependent upon the

Table 1. Classification of funds of the 104 young farm-operator families made available for family use from sources other than family income 1957.

Funds made available	Percent having	Average amount per family ($)
Reduction in savings, sale of assets to raise cash:		
(a) To pay family expenses	15	165
(b) To pay farm expenses*	11	212
Increase in amounts due on installments		
(a) Family's share car or truck payments	19	87
(b) Household furnishings and equipment for family	24	40
(c) Farm share car, truck or tractor payments*	21	129
Increase in other debts for family living:		
(a) Unpaid debts	8	28
(b) Borrowed money not repaid	8	111
Increase in other debts for farm business*		
(a) Unpaid debts	10	151
(b) Borrowed money not repaid	13	281

*Includes negligible amounts in connection with business other than farm.

Table 2. Disposition of money received during the report year but not used for current family expenditures by 104 young farm operator families, Mississippi 1957.

Funds made available	Percent having	Average amount per family ($)
Investment in land or home	43	262
Improvement in home	16	166
Savings and investments in farm other than land*	36	444
Insurance premiums	91	133
Loans to others not repaid	4	13
Payments made on auto or truck bought more than a year ago, family share	28	102
Payments made on auto, truck, or tractor bought more than a year ago, farm share*	61	569
Back debts, family living paid	7	16
Other back debts of farm paid*	9	251

*Includes negligible amounts in connection with business other than farm.

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[7] See footnote 2 (a) for reference.

farm. The vast majority of these farm sons and farm housewives had had no gainful experience in non-agricultural work since leaving school.

In the second study made in the thirties, previously mentioned, net family incomes and expenditures of young farm operator families was obtained.[8] Incomes averaged $308 and family expenditures $277 for the report year 1938-39.

Housing facilities and equipment of families in the 1938-39 and present studies differed greatly. All families in the present study and 14 percent in the 1938-39 study had electricity. In the present study 77 percent of the families had a kitchen sink with a drain, 64 percent a flush toilet, 99 percent a mechanical refrigerator. Percentages for families in the 1938-39 study with these facilities were none, none and two respectively.

There are several factors that are related to differences in income, family living expenditures and housing facilities of families in the two periods. One is a difference in time. The same man who earns $7035 a year today can purchase only as much as his counterpart earning $3,000 a year in 1939. The present is a period of inflation and relative high levels of living.

The 1938-39 study was made in 5 counties representative of the group classified at that time by the Land Use Planning Section, Land Use Division, Farm Security Administration as least suitable for permanent arable agriculture. (Ittawamba, Attala, Lauderdale, Clarke and Forrest Counties). The counties included in the present study are representative of the main soil areas of the State.

In the farm-operator group of the present study 32 percent of the homemakers had off-farm work. In the 1938-39 study the farm operator group included only those families in which the wife had no off-farm work.

But even more important is the fact that since 1938-39 we have had another world war with provision for vocational training and schooling of veterans. Many youth have left the farm. More off-farm work is available in Mississippi as well as in other areas. There are opportunities for ambitious youth on the farm—opportunities to get training at modern techniques of farming; opportunities to purchase land at low interest rates.

Summary

It was the purpose of this study to find out how young farm-operator families in representative areas of Mississippi live and their problems. Data were obtained by personal interview with the use of a schedule from about 20 families in each of five counties (Coahoma, Jefferson Davis, Madison, Pontotoc, and Winston) representing the main soil types in Mississippi. Only families with farm operators under 40 years and with both husband and wife having kept house the year preceding the interview were included. The 104 families averaged 4.19 persons. Seventy percent of the families owned some farm land. Of those owning land only 19 percent had inherited part or all of it. Seventy-four of the 104 families had received no substantial assistance from family or relatives in getting started in farming either in the form of gifts or loans of land, money, livestock or housefurnishings and equipment.

For 1957, the year preceding the interview, the average net income of the families was $3902. Fifty-four percent of the net income was derived from farm operation; 41 percent from off-farm earnings. Five percent was other money income.

Families in this study spent an average of $3179 for family living. Money expenditures for food were $735 or 23 percent of the amount spent for family living. The value of home-produced foods used during the report year was $564.

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[8] See footnote 2(b) for reference. In the study here reported about two-thirds of the farm operator families are owners, one-third renters and croppers. In the former study only 29 percent were farm owners. Therefore, data reported from the 1938-39 study are weighted so as to be comparable with the present study. Incomes, expenditures and other data for owners are given the weight of two-thirds, of renters and croppers one-third.

Twelve percent of the total expenditures was for clothing, clothing services, and personal care; 22 percent for housing (including expenditures for the house, household operation and household equipment and furnishings); 14 percent for auto and other travel; 8 percent for health; 5 percent for recreation; 5 percent for religion, community welfare, gifts; 7 percent for personal taxes and social security payments; 2 percent for each tobacco and all other.

The families included were well housed. Only 5 percent lived in houses classified as in poor condition. All had electricity. Eighty-two percent had water piped into kitchens.

The health of the great majority of husbands and wives in these families was rated as good. Only 17 percent of the families mentioned a health problem.

At the time of the interview 90 percent of the families owned a radio or radio-phonograph; 83 percent a television set; 29 percent a record player and 23 percent a piano.

Religious organizations (such as church, Sunday School, missionary society, young people's unions, brotherhood) were those attended regularly or occasionally during the past year by most husbands and wives. Those not attending any organization regularly (19 husbands and 16 wives) often gave as a reason, "young children", "need a rest", "distance to meeting place", "not in habit", "no time."

Sixty-three percent of the families drew on assets or increased debts to make funds available for family use. More used the installment plan and larger amounts were involved than for other forms of credit. These families went in debt or reduced assets for farm expenses much more than for family expenses.

All families used some of their income to increase their assets and to decrease debts. Largest amounts were involved in payment on auto, truck or tractors (farm share) bought more than a year ago.

Many farm operators mentioned the expense of modern farming and the need for help in reducing farming costs.

Taken as a whole the 104 families showed a net surplus of $752. Sixty-seven percent had net surpluses, 33 percent net deficits.

Long-time plans of the 104 families most often included improvements in their home and its equipment.

From data available from similar studies made in Mississippi during the thirties it would seem that young farm families have much higher levels of living today. Two factors in this improvement seem to be (1) large shift of youth out of farming; (2) more assistance than formerly (in form of training, such as balanced farm and home planning, veterans farm training, loans at low rate of interest, and the like) to those who choose farming as a career.

Implications

This study has uses and/or implications for young farm-operator families as well as for agriculturists, home economists and other educators.

A list of expenditures by similar farm families might be used to check expenditures of one's own family. For example, families in this study spent $3179 for family living. Our family spends about $4,000. We might check reasons for differences and make an analysis of each. For example, the study family spends much less on food than our family. In this case we might want to check our food purchases and foods home-produced and decide if changes might be made without sacrificing nutritional values and family satisfactions.

This study points to the need for certain emphases in educational programs directed towards young farm families. Some of these are:

(1) **The purchase, use and care of mod-**

ern farm equipment (including cars and trucks). Modern farm equipment and its upkeep is very expensive. The young farm operator in this study often spoke of the need for assistance in selection, financing and using this equipment.

(2) **The house and its equipment.** In the past, it was often a question of desire for better housing. Families in this study had the desire. In fact, better housing in one form or another was included in the long-time plan of practically every family. The real problem here is in selection and financing the better housing they had purchased.

(3) **Food buying.** These young farm operator families spent relatively more for food than other types of consumer goods. It is important that both husband and wife know the foods needed for an adequate diet and what qualities to look for in making purchase for specified purposes.

(4) **Greater participation in community organizations.** Participation of these young families seemed to be almost altogether limited to the church. Ways and means need to be developed whereby young farm families will participate more in other organizations of the community.

(5) **More emphasis on balanced farm and home planning.** It is difficult to compare families in different counties working under different farming situations. But from the data here reported it would seem that families in the balanced farm and home planning program are somewhat more efficient farmers.

APPENDIX TABLES

Table 1. Average income of young farm-operator families in five counties of Mississippi during 1957.

Type income	Coahoma	Jefferson Davis	Madison	Pontotoc	Winston
Net from farming ($)	4160	650	4505	897	655
Off-farm earnings ($)	2026	2177	933	1147	1744
Other money income ($)	120	274	258	226	165
Total income ($)	6306	3101	5696	2270	2564
% with off-farm earnings	55	81	45	65	96
% with other income	45	57	65	45	30
Number families	20	21	20	20	23

Table 2. Average net income, family expenses, and number families with a deficit and with a surplus and average amounts of the deficit and of the surplus, young farm-operator families in five counties of Mississippi during 1957.

Type income	Coahoma	Jefferson Davis	Madison	Pontotoc	Winston
Total income ($)	6306	3101	5696	2270	2564
Family expenses ($)	5426	2614	3436	2210	2269
Number with deficit	10	7	2	9	6
Av. amount for those with deficits ($)	1524	486	1612	843	1291
Number with surplus	10	14	18	11	17
Av. amount for those with surplus ($)	1877	931	2619	729	865

Table 3. Percentage of young farm-operator families having expenses for specified family living items and average expense per family during 1957.

Item	Percent families having expense	Average expense per family
		Dollars
Food at home	100	583
Drinks, snacks away from home	87	44
School lunches	58	36
Other meals away from home	52	58
Vitamins and minerals	39	14
Clothing	100	263
Clothing services	95	38
Toilet articles	100	38
Barber and beauty parlor services	93	43
Rent, taxes,* insurance on house	39	44
Lodging away from home	18	13
Repairs and replacements on house	38	38
Gas, electricity, fuel, ice, telephone, etc.	100	254
Freezing supplies, rent of locker	52	8
Laundry sent out	23	7
Wages for household help	45	104
Laundry, cleaning and other supplies	100	55
Furnishings and household equipment	93	171
Auto** or truck operation	95	253
Auto** or truck purchase	25	179
Other travel	21	21
Medical care	98	195
Blue Cross and other health policies	58	70
Reading material	83	26
T.V., radio, piano	14	26
Repairs on recreational equipment	24	8
Dues to clubs or organizations	70	12
Paid admissions	70	18
Toys for children	79	47
Sports equipment	62	26
Education	57	20
Religion, gifts, community welfare	97	153
Tobacco	69	73
Income, poll, and other personal taxes	90	150
Social security payments	83	66
Other family expenses	55	25

*Housing expenses entered as family living expenses only when paid separate from farm expenses. Entry made under farm expenses if paid with farm.

**Only family's share charged as a family expense. Thus if car or truck was used 10,000 miles and one-half the mileage was for farm use, one-half for family use, one-half of the operating expenses or payments charged as family living expense, one-half as a farm expense.

Table 4. Percentage of young farm-operator families using specified home-produced foods and fuel and average values per family of amounts used during 1957.

Item**	Percent families using	Average value*** per family
		Dollars
Dairy products	77	100
Eggs	81	50
Poultry	71	15
Pork	76	74
Other meats	57	39
Fish, game, birds	63	8
Potatoes	76	19
Fresh tomatoes	94	9

(Continued on page 16)

Table 4. (Cont.) Percentage of young farm-operator families using specified . . .

Other fresh vegetables	99	172
Fresh fruits	83	13
Syrup	14	2
Cornmeal	39	9
Nuts	32	7
Popcorn	9	*
Tomatoes (canned)	63	4
Other fruits and vegetables (canned)	72	15
Pickles and relishes	74	3
Jellies and jams	71	4
Other fruits and vegetables (frozen)	69	20
Other fruits and vegetables (dried)	25	1
Total	100	564
Fuel (fire or stovewood)	45	98

*Less than .50.

**Includes foods obtained from woods, streams, fields.

***Home-produced foods eaten by the household in 1957 were valued at the price the farmer could have received for them if he had sold them. Prices compiled by the Marketing Service of the United States Department of Agriculture for Mississippi were used inasfar as possible. Where prices were not available and the food was sold locally most typical prices received by local farmers selling the same were used.

Table 5. Net change in assets and liabilities of 104 young farm-operator families in Mississippi during 1957.

Item	
Average net money income ($)	3902
Average expenditures for family living ($)	3179
Surplus	
Percent of families	67
Average amount ($)	1648
Deficit	
Percent of families	33
Average amount ($)	1112
Average annual change in net worth* ($)	+752**
Percent of income	19.3

*Changes resulting from actual money trasactions.

**Negative amounts indicate a net deficit; positive amounts a net surplus; average change in assets and liabilities do not equal the exact difference between money income and money expense. In accepting a schedule an error of 10 percent of the income or expenditure, whichever was greater, was allowed.

Table 6. Goals of farm families for the next ten years.

Goals*	Percent
Major household equipment of specified kinds like home freezer, air conditioner, washing machine	31
New home, own home, better house, rebuild house	29
Own land, own farm, more land, buy land and relocate, pay for farm	19
Remodel house, add rooms, add patio, another bedroom, etc.	23
New car, better car or another car	13
Add household furniture of specified kind as new furniture, bedroom suite, couch, chairs, tables, living room suite	13
Get a T.V., radio , record player or piano	3
Farm equipment of specified kinds as tractor	11
Running water in house	9
Repair house such as painting, redecorating, papering, floors refinished	10
Add bathroom plumbing, add hot water heater	12
Making farm improvements as Grade A dairy, hog pasture, add livestock, clear new pasture, change breed of cattle, terracing work	9

*Other plans included: Complete house or finish house; adding farm buildings of specified kinds; deep well—electric pump; college education for child; central heating and cooling system; landscaped ground or lawns.

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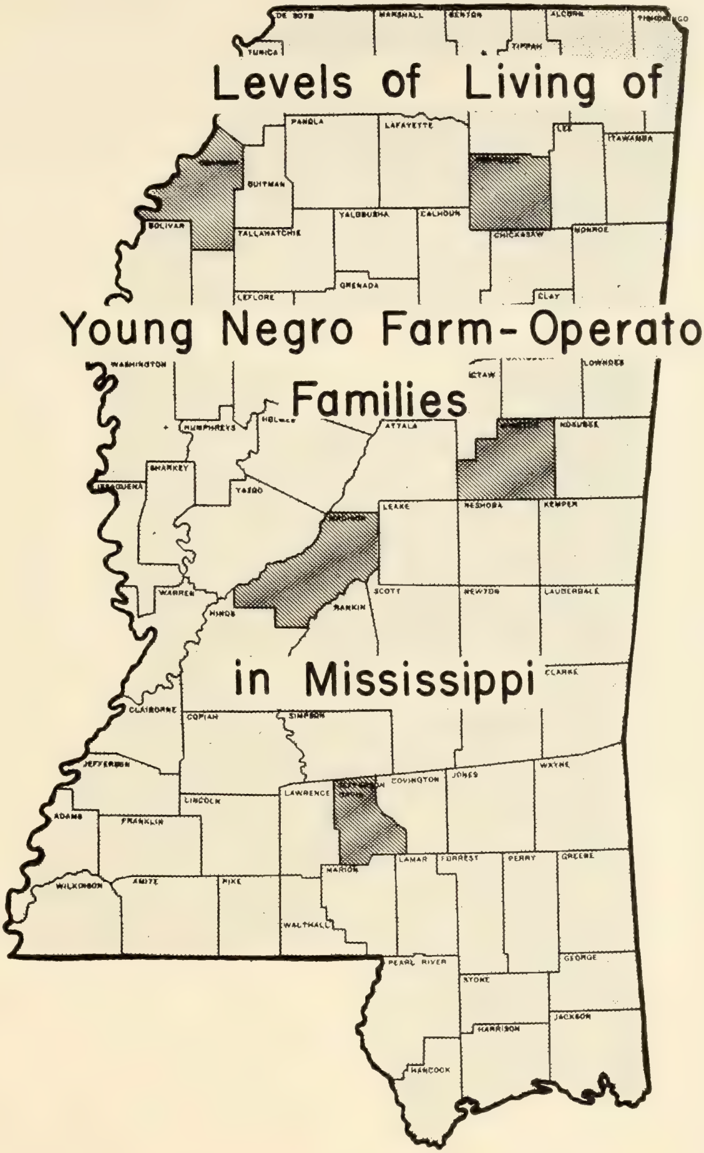
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WASHINGTON
LOWNDES
HUMPHREYS
HOLMES
ATTALA
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Levels of Living of Young Negro Farm-Operator Families in Mississippi

Mississippi State University

AGRICULTURAL EXPERIMENT STATION

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LEVELS OF LIVING OF YOUNG NEGRO FARM-OPERATOR FAMILIES IN MISSISSIPPI[1]

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INTRODUCTION

During the business depression of the thirties a nation-wide study was made of rural family living by the Bureau of Home Economics in the United States Department of Agriculture. Included in this study was a large sample of Mississippi Negro cotton farm-operator families[2]. Then in 1947 income and related data were obtained by interviews with 269 Negro farm families in Bolivar County, Mississippi.[3] Similar information is not available for a period of relative prosperity such as the present time.

It is the purpose of this study to bring up-to-date the information on levels of living of Negro farm families. The study is limited to **young** farm families since it is known that this group will adopt recommendations for improvement more readily than older farm families. Furthermore, they have problems in family financial management different from those of older families. Information provided by this study can serve as a basis for guidance in educational programs and counseling services, especially important to today's youth.

Selection Of Families

A soils specialist in the Mississippi Agricultural Experiment Station was consulted for the names of counties to represent principal soil types in the State. The following counties were selected: Coahoma, Jefferson Davis, Madison, Pontotoc, and Winston.

According to estimates made from the 1955 Agricultural Census data only 19 percent of the Negro farm operators were under 35 years of age, the age originally planned to include in the young farm operator group.

All farm operators under 35 years would, however, not be eligible for our study since only farm-operator families with both husband and wife who had kept house during 1957 were to be included in this study. Also, the study was limited to families who operated farms in which the value of products sold during the report year was $250 or more. To reduce the expense of obtaining data from families it was decided to include families in which the operator was under 40 years of age rather than under 35 years.[4]

County and home demonstration agents in the five counties were asked to select several neighborhoods including both better and poorer farming areas and to list some families who were probably eligible in each of these neighborhoods. Lists were enlarged by the interviewers when they visited the neighborhoods. Farm-operator families visited sometimes knew of other eligible families nearby. Also, suggestions were given by school principals, country store owners, and other neighborhood leaders. The number of eligible families was very limited in all five counties. Schedules were completed for 100 families or approximately 20 families in each of the five counties by interview with husband and wife with the use of a schedule.

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[1] This is the second report of a study of young farm-operator families. The first report gives a similar analysis of 104 young white farm-operator families.

[2] Family Income and Expenditures, Farm Series, Consumer Purchases Study, Misc. Pub. No. 465, USDA 1941.

[3] The Labor Supply and Mechanized Cotton Production, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. 463, June 1949.

[4] Two families were included in which the operator was 40 years of age at the time of the interview, but these two had been 39 most of the report year, 1957.

Description Of Families

Husbands (or farm-operators) in 78 of the families included were 30-39 years of age. This large number in the upper age limit seems to check with census data that fewer and fewer young Negroes in the State are operating farms. Fifty percent of the homemakers in the 100 families were 30 - 39 years of age. Homemakers in four families were older than 39 years; the remaining were under 30 years.[5]

Husbands had completed an average of 7 grades; wives an average of 9 grades. Thirty-four husbands had had G.I. training of one or more kinds. For the majority this G.I. training was farm training. Twenty-five had had G.I. farm training. Eleven of the 100 families participated in the balanced farm and home planning program of the Agricultural Extension Service.

Members of the economic family averaged 5.95 persons. By economic family is meant the members dependent upon family funds for most of their support. Only 14 of the 100 families had no children.

Tenure and Assistance in Getting A Start in Farming

Every family was asked about the main farm tenure or tenure of the major part of the land cultivated during the past year. Main tenure was as follows:

Main Farm Tenure Past Year	Percent
Owner	34
Share cropper	33
Share renter	25
Cash renter	6
Use of relatives' lands*	2

*Relative pays the taxes.

Thirty-six percent of the families owned some farm land. The number of acres owned by families owning averaged 79 and ranged from 16 to 400 acres. Families were asked about how they acquired their land and 85 percent said they purchased it, 15 percent said they inherited it. Most of the families had purchased their land in the forties.

All families were asked about assistance in the form of money, house-furnishings, farm equipment or livestock which they had received before and since marriage from their family or other relatives. Eight families reported such assistance before marriage; four since marriage. Assistance listed included outright gifts, as well as a few loans.

Among items reported were a gift of $300 in cash; a cow, hogs and chickens; beds and bedding. Eighty of the 100 families had received no substantial assistance from family or relatives in getting started in farming either in the form of gifts or loans of land, money, livestock, or housefurnishings.

Getting A Living

The net income of the 100 families during 1957, the year preceding the interview, ranged from $126 to $5,132. It averaged $1307. By net income is meant the sum of net receipts (1) from farm operation; (2) from off-farm work; (3) from other non-farm income except non-recurrent income such as inheritances. Net incomes of the families were distributed as follows:

	Percent
Under $1,000	44
$1,000 - $1,999	39
$2,000 - $2,999	12
$3,000 and over	5

The net income of the families in the five counties ranged from an average of $1090 in Coahoma County to an average of $1570 in Madison County (See Table 1 in the Appendix). In figuring income no deductions were made for depreciation on buildings and equipment owned and no consideration for changes in inventories.

Gross income from farm operation averaged $1158. This average is based on incomes from 67 families. The 33 sharecropper families reported their net income from farm operation (that is, the amount advanced by the landlord during

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[5] One was 43 years old and the other three 40 years of age.

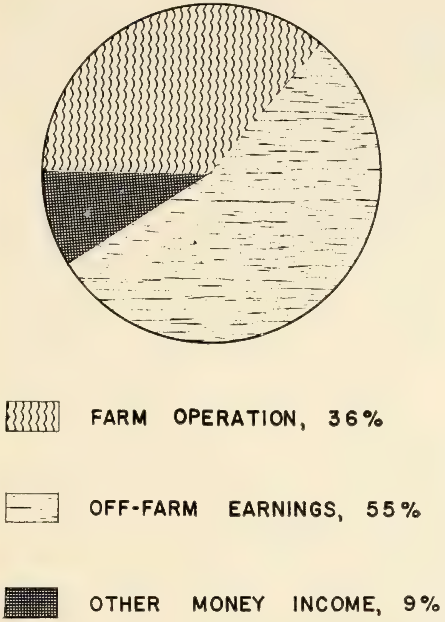

Figure 1. Percentage of net income of 100 young farm-operator families classified by source of income.

1957, the value of groceries, medical and other bills paid by the landowner during 1957 and the amount received at settlement) rather than gross farm income and farm expenses since this is the type of information they could furnish. The farm expenses of the 67 other families averaged $668 or 58 percent of the gross farm income.

Net from farm operation averaged $490. This amount differed only slightly from the net farm income of the entire group which averaged $475. The amount from farm operation was 36 percent of the total net income (See Figure 1).

Fifty-five percent of the net income of families in Jefferson Davis County and 45 percent of those in Coahoma County were derived from farm operation. The percentage in Winston County was 43 and in Pontotoc and Madison Counties 31 and 13 respectively.

Gross receipts from farm operation of Madison County families were about average but farm expenses were much above average. One half the operators in the Madison County sample had worked more than 100 days off the farm and some of these had considerably more expenses than the family whose operator worked full time on the farm. Madison County families averaged much higher incomes from off-farm work than did families in the other four counties.

Homemakers were questioned about specified farm tasks which they had done during the past year, whether they did them often, sometimes, or never. Ninety-five percent of the homemakers said they did field work either often or sometimes, 56 percent reported caring for farm livestock and 31 percent doing errands in connection with the farm.

The average amount earned from off-farm work by members of the 100 families during 1957 was:

Husband	$517
Wife	174
Other members	31
Total	$722

Sixty-eight percent of the farm operators and 18 percent of the wives had had earnings from off-farm work during this period. Earnings from farm wage work done on the farm of another were classified as earnings from off-farm work.

The majority (67 percent) of these families had received during the report year larger amounts from farm products sold than from off-farm earnings. But net receipts from farm operation were less than were net receipts from off-farm earnings (See Figure 1).

Twenty percent of the families had "other money income". "Other money income" included pensions, welfare payments, G.I. payments, net income from business owned but not operated, interest or dividends and the like. The average amount of such income received by the 100 Negro families was $110 or nine percent of the total net income (Figure 1).

Manner of Living

The manner of living of a family is

best described by the goods and services it uses either purchased or home-produced; its housing and equipment; and the part it plays in the community.

Expenditures for family living of the 100 families during 1957 ranged from $343 to $4912 with an average of $1400. Average expenditures for family living ranged from a low of $962 in Winston County to a high of $1694 in Madison County, see Table 2 in the Appendix. Expenditures for family living were related to family income except for Coahoma County where incomes were least and expenses only slightly under those of Madison County families. Coahoma County families were for the most part cotton farm families. Excessive rains during 1957 had had an adverse effect on the cotton crop. Expenditure patterns of families were based on customary income; that is, a higher income.

Expenditures for family living during 1957 varied with net income during this period as follows:

Net income	Average expenditures per family
Under $1,000	$ 896
$1,000 - $1,999	1650
$2,000 - $2,999	1788
$3,000 and over	2662

Expenses for food during 1957 ranged from $123 to $1666 and averaged $450 or $89 per family member. Expenditures for food include expenditures for drinks and snacks eaten away from home; for other meals including lunches taken in school lunch rooms; and for vitamins and minerals as well as for food used at home including that in packed lunches eaten away from home (See Table 3 in Appendix). Money expenditures for food were about one - third (32 percent) of the amount for family living (Figure 2).

All families in this study produced some food for family consumption. Included as home-produced were foods obtained from woods, fields, streams, such as wild fruit, game, fish, as well as foods actually produced such as beef, milk, beans, eggs, etc. The values of these foods ranged from $64 to $1815, with an average of $670 (See Table 4 in the Appendix for specified kinds of home-produced foods used).

Families were questioned about the type of food production activities husbands had done during 1957. Seventy-seven percent reported husbands cared for hogs often; 59 percent that he worked in the garden often. Forty-nine percent said the husband cared for poultry, 46 percent that he cared for the milk cow, and 44 percent that he milked often. One fourth or fewer husbands were reported as doing often activities traditionally done by women; i.e. assistance in canning and preserving, gathering vegetables and dressing poultry.

The 100 families spent an average of $239 for clothing, clothing services, and personal care. This is 17 percent of the total family living expenditures (Figure 2).

One hundred and eighty-two of the $239 was for clothing. Clothing expenditures ranged from $10 to $700. Expenditures for clothing services averaged $20 and those for personal care, $37. Twenty-three dollars of the amount spent for personal care was spent for services at the beauty parlor and barber shop. The remainder ($14) was spent for products used in personal care, such as toilet soap, cosmetics and the like. (See Table 3 in the Appendix).

The 100 families included spent an average of $215 on the house, its operation, furnishings and equipment during 1957. This is 15 percent of the expenditures for family living (Figure 2) and less than was spent for either food or clothing and personal care.

Houses in which the families resided had an average of 4.4 rooms. The average number of bedrooms per family was 2.5. Nearly one fourth of the families lived in houses in which the exterior of the house had been painted in the last 5 years.

Families were classified according to house type.[6] These types were as follows: (1) Six rooms or more in good condition; (2) Six rooms or more in medium condition or 5 rooms in good condition; (3) Six rooms in bad condition; (4) Five rooms in medium condition; (5) Four rooms or less in good or medium condition; four rooms or less in back of store; (6) Five rooms or less in bad condition. Houses of the families included when classified into the six types were distributed as follows:

Housing type	Percent
1	2
2	15
3	6
4	12
5	33
6	32

Household operation took about one-half (53 percent) of the housing dollar of

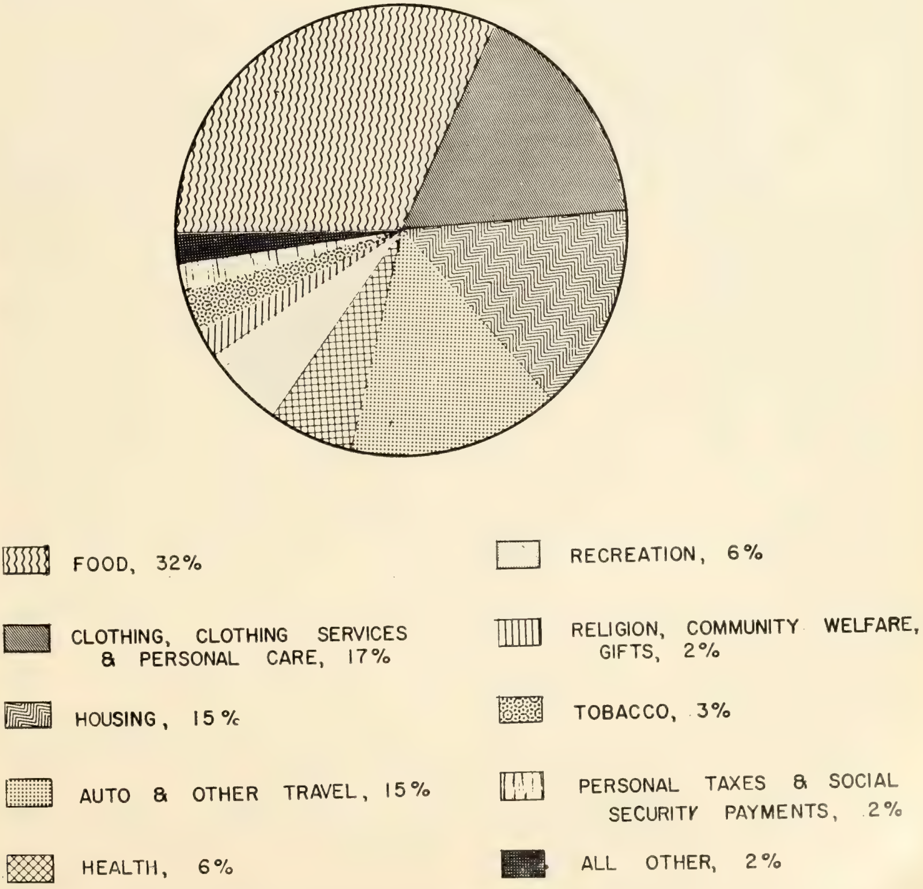

Figure 2. Percentage of total expenditures for family living of 100 young farm-operator families classified by source of expense.

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[6] The housing types and directions for classifying are based on a classification developed by Lloyd Warner. See "Social Class in America" by W. Lloyd Warner, Marchia Meeker and Kenneth Eells. Science Research Associates, Chicago, Illinois, 1949, Ch. 8.

these families. Included under household operation expenses are such things as cost of utilities such as electricity and gas, cleaning and other household supplies; freezing supplies and locker rental; laundry sent out.

Eighty-seven percent of the families had electricity. Eighteen percent had water piped to their kitchen. Six percent had water piped to the bathroom and eleven percent had a kitchen sink. Twenty percent of the families heated with gas. The usual type of heater was the gas radiant. Eighty-three percent of the families obtained some fire and/or stove wood from nearby wooded areas (Table 4 in the Appendix).

Expenditures for furnishing and equipment ranged from 0 to $704 with an average of $82 (See Table 3 in the Appendix). Shown below is the percentage of families owning household equipment of specified kinds:

Equipment	**Percent owning**
Electric iron	86
Mechanical refrigerator	73
Gas cook stove	46
Sewing machine (all kinds)	38
Washing machine (all kinds)*	34
Electric fans (movable)	29
Home freezer	14
Pressure cooker	14
Electric sewing machine	10
Window fans	10
Electric cook stove	7
Pressure sauce pan	7
Rent frozen food locker	4
Own other electric household equipment**	3

*One family had an automatic machine.

**Mixer and/or toaster.

Families were questioned about nine kinds of homemaking activities possibly performed by husbands during the past year (cooking, food marketing, care of children, upkeep of lawns, washing dishes, washing clothes, hanging out clothes, ironing clothes, general cleaning). Food marketing, care of children, upkeep of lawns were the homemaking activities most often checked as performed often and sometimes during the past year by husbands. Ironing clothes, washing dishes, and hanging out clothes were activities most frequently checked as never done.

These 100 families spent about the same for "auto and other travel" as they had spent for housing (See Figure 2). Average expenditures for auto and/or truck and other travel were $204. (Only $15 of the $204 was for "other travel") (Table 3 in Appendix). Seventy of the 100 families had an auto and/or truck they used for the family. (Only the family's share of use of auto or truck was regarded as a family expense). About one-fifth of the families (19 percent) had purchased an auto and/or truck they used for family living during 1957. These autos and/or trucks were for the most part bought second hand.

Expense of "other travel" was usually incurred by those without an auto and/or truck. Thirty percent of the families had an expense for "other travel".

Average total expenditures for health including medical care and insurance payments was $77 (Table 3 in Appendix). This is 6 percent of the total expenditures for family living (Figure 2). In addition, an average of $13 was received from insurance companies for illnesses of family members. Seven families received these payments averaging about $186 each. One family received $100 from a burial policy. Only 25 of the 100 families had Blue Cross or other health policies.

During the report year 27 of the homemakers had lost time from usual activities due to childbirth or causes related to pregnancy. In eight families there had been accidents causing loss of time. There had been 17 visits in hospitals by members in the 100 families. Fifteen percent of these families had had someone in the hospital during the report year.

These 100 families could be classified on the whole as healthy families. The health of only three husbands and two wives was rated as poor. The health of 83 percent of the husbands and of 77 percent of the wives was rated as good. Health of the remainder was rated as fair. Seventeen percent of the families said they had a health problem. Six families mentioned children with a health problem — in four of these it was asthma. Three mentioned health problems in connection with parents residing with them and 8 problems of either husband or wife, such as ulcerated stomach, hernia, arthritis, and thyroid trouble.

Families in this study spent during 1957 an average of $83 for recreation (or 6 percent of total expenditure). See Figure 2. Television sets and radios took the largest average amount ($31); next, sport equipment; and third, toys for children (See Table 3 in the Appendix). All families had some expense for recreation items of one type or another.

During the report year 11 families purchased television sets; 5, radios or radio-phonographs. At the time of the interview the following percentage owned entertainment equipment of specified kinds:

	Percent
Radio or radio-phonograph	82
Television set	39
Record player, phonograph	10
Piano	3

The family was asked about organizations the husband and wife had attended regularly and occasionally during the past year and whether or not they had held any office or served on a committee in connection with participation in the organization. The average number of organizations attended regularly or occasionally by the husband and wife was:

	Husband	Wife
Religious	1.7	1.9
Agricultural	.1	.2
All other	.2	.2
Total	2.0	2.3

Religious organizations included church, Sunday School, burial club (to care for those who could not pay expense for burial), missionary society, or church circle. Agricultural organizations included home demonstration clubs, community clubs, 4-H clubs, Farm Bureau. Other organizations included lodge, PTA, sewing club, Scouts (scout leader). Average number of offices or committee assignments held by husbands was .4 and that by wives the same.

Nineteen husbands and 16 wives had attended during the past year no organization regularly. Those individuals (husbands and wives) not attending any organization regularly were asked, "Why not?" Typical replies were: "Have too many children", "Too busy", "Not in habit", "No transportation", "Need more clothes", "Slackened up", "No money to buy gas".

Homemakers were asked if they had entertained at meals the past year relatives, friends, group meetings. Eleven percent had done no entertaining whatever. Eighty-five percent had entertained relatives and 72 percent friends. Group meetings had been entertained in the homes of 14 percent. Some of the groups entertained were: band meeting, home demonstration club, missionary society, youth meeting.

The 100 families spent an average of $45 per family for tobacco, smoking, chewing and snuff including smoking supplies such as ash trays and pipes. Expenditures ranged from none to $182. About three-fourths of the families (77 percent) had expenditures for tobacco (See Table 3 in Appendix).

Seventy-two percent of the families had children in school. Expenditures for education including such things as papers, pencils, tuition, special lessons averaged $16 per family (textbooks are furnished in public schools by the State). Expenditures for education ranged from 0 to $112.

Practically all families (96 percent) made some expenditures for religion, gifts, and community welfare. The average expenditure for these items was $33. Amounts spent for these items ranged from 0 to $300.

Seventeen percent of the families reported expenditures for income, poll and/or other personal taxes. (See Table 3 in Appendix). The average amount for these taxes for all 100 families was $4. Forty-two percent of the 100 families had made expenditures for social security payments. These payments averaged $24 per family.[7]

Included in other family living expenses were items such as interest for money borrowed for family living, birth certificate, notary and lawyer fees, funeral and cemetery expense not covered by insurance. These other expenses averaged $10 per family.

Funds Available Other Than Family Income

Seventy-one percent of the families increased debts or drew on assets to make funds available for family use. The average increase in these debts and decrease in these assets was $385 per family.

More young farm-operator families used the installment plan and larger amounts were involved than were other forms of credit (Table 1). This type of credit was used for cars, trucks and tractors as well as for household equipment and furnishings.

These families went in debt or reduced assets for family expenses more than for

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[7] Only income, poll and other personal taxes are included in this section. Other taxes such as excise and sales taxes are merged with goods and services to which they apply. Taxes on business operation and income-producing property were deducted in estimating net income. Social Security payments are also regarded as taxes. They include those paid separately as farm operators and amounts deducted from off-farm earnings.

Table 1. Classification of funds of 100 young farm-operator families made available for family use from sources other than family income 1957.

Funds made available	Percent having	Average amount per family
Reduction in savings, sale of assets to raise cash:		$
(a) To pay family expenses	12	67
(b) To pay farm expenses*	6	32
Increase in amounts due on installments		
(a) Family's share car or truck payments	11	33
(b) Household furnishings and equipment for family	36	44
(c) Farm share car, truck or tractor payments*	9	50
Increase in other debts for family living:		
(a) Unpaid debts	26	45
(b) Borrowed money not repaid	13	25
Increase in other debts for farm business:*		
(a) Unpaid debts	11	20
(b) Borrowed money not repaid	17	69

*Includes negligible amounts in connection with business other than farm.

Table 2. Disposition of money received during the report year but not used for current family expenditures by 100 young farm-operator families, Mississippi 1957.

Funds made available	Percent having	Average amount per family
		$
Investment in land or home	8	36
Improvement in home	3	4
Savings and investments in farm other than land*	12	55
Insurance premiums	87	19
Loans to others not repaid	5	3
Payments made on auto or truck bought more than a year ago, family's share	23	55
Payments made on auto, truck, or tractor bought more than a year ago, farm share*	40	115
Back debts family living paid	10	13
Other back debts of farm paid*	3	4

*Includes negligible amounts in connection with business other than farm.

farm expenses. Debts incurred for family living were in some cases so great that there were limited funds to put on the farm.

Disposition Of Money Received But Not Used For Current Family Expenditures

Ninety-six percent of the families used some of their income to reduce their debts and increase their assets. The average amount used for this purpose was $304. Largest amounts were involved in payments on auto, truck or tractors bought more than a year ago. But more families paid premiums on insurance, burial and life (usually burial). See Table 2.

Surpluses and Deficits

Forty-three percent of the families had net surpluses; that is, money income exceeded current expenditures during 1957. These surpluses amounted to an average of $448. More Pontotoc and Winston County farm-operator families had surpluses and had larger surpluses than did families in the other three counties (See Table 2 in Appendix).

Fifty-seven percent of the families spent more than their money income and incurred net deficits averaging $484. More Jefferson Davis and Coahoma farm-operator families had deficits than families in the other counties. These families had less off-farm earnings than families in the other counties. The year 1957 was not a good crop year, especially for cotton which was the main crop of many of the families.

Taken as a whole, the 100 families showed a net deficit of $81. See Table 5 in Appendix.

Goals For The Next Ten Years

"Are there things you plan to have in the next ten years that you do not have?" This was a question asked each of the 100 families. If they replied "Yes" they were asked "What?" Only 5 percent of the families replied "No" to this question. Most families named several items. A classification of the replies is given in Table 6 in the Appendix. The goals most often mentioned by these families were ownership of major household equipment (42 percent) such as home freezer, washing machine. The goal next in importance was a new home, a better house, rebuild house (37 percent). The goal third in importance was entertainment equipment; i.e. television set, radio, record player or piano (18 percent). Next mentioned was a better car, another car (16 percent). (See Table 6 in the Appendix).

These families mentioned improved farm facilities also. About one third mentioned one or more items concerning the farm — such as, own a farm, be a farm renter, more land, a tractor, add livestock, clear land for a pasture, terracing work, addition of a farm building.

Income And Family Living Now And In Two Previous Studies

Net family incomes in the 1936 study previously referred to averaged $295; family living expenses averaged $259.[8] Twenty-one percent owned an auto and/or truck in this 1936 study. In the present study 70 percent owned an auto and/or truck.

Housing facilities and equipment of families in the 1936 study and in this study differed greatly. Eighty-seven percent of the families in the present study and less than one percent of those in the 1936 study had electricity. In the present study 18 percent of the families had water piped to the kitchen, 6 percent water piped to the bathroom. The percentages in the 1936 study with each of these facilities was less than one.

There are several factors that are related to differences in income, family living expenditures and housing facilities of families in the two periods. One is a difference in time. It takes about 2.34 more income today to purchase the same things as in the late thirties. The present is a period of relatively high prices.

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[8] In the study here reported (See footnote 2 for reference) about one-third of the families were sharecroppers. Therefore, data reported from the 1936 study are weighted so as to be comparable with the present study. Incomes, expenditures, and other data from sharecroppers are given the weight of one-third; families with other tenure, two-thirds.

But even more important is the fact that since 1936 we have had another World War with provision for vocational training and schooling of veterans. Many youth have left the farm. More off-farm work is available in Mississippi as well as in other areas. There are opportunities for ambitious youth on the farm—opportunities to get training in modern techniques of farming, opportunities to supplement income from farm operation.

The study made in 1947 in the Delta plantation areas of Bolivar County, Mississippi, previously mentioned, likewise give comparable data.[9] The average income of these Negro Delta families was $590. Five hundred of this amount or 85 percent of it was derived from farm operations. Negro families in this study who resided in Coahoma County, also in Delta plantation areas, derived 46 percent of their income from farm operation, 43 percent from off-farm work and 11 percent from other income sources. This difference gives some indication of the changes that are taking place.

Summary

It was the purpose of this study to find out how young farm-operator Negro families in representative areas of Mississippi live and their problems. Data were obtained by personal interview with the use of a schedule from about 20 families in each of five counties (Coahoma, Jefferson Davis, Madison, Pontotoc, and Winston) representing the main soil types in Mississippi. Only families with farm operators under 40 years of age and with both husband and wife having kept house the year preceding the interview were included. The 100 families averaged about six persons. Thirty-six percent of the families owned some farm land. Of those owning land only 15 percent had inherited it. Eighty of the 100 families had received no substantial assistance from family or relatives in getting started in farming, either in the form of gifts or loans of land, money, livestock, or housefurnishings and equipment.

For 1957, the year preceding the interview, the average net income of families was $1307. Thirty-six percent of the net income was derived from farm operation; 55 percent from off-farm earnings.

Families in this study spent an average of $1400 for family living. Money expenditures for food were $450 or 32 percent of the amount spent for family living. The value of home-produced foods used during the report year was $670.

Seventeen percent of the total expenditure was for clothing, clothing services, and personal care; 15 percent for housing (including expenditures for the house, household operation and household equipment and furnishings); 15 percent for auto and other travel; 6 percent for health; 6 percent for recreation; 3 percent for tobacco; 2 percent for religion, community welfare, gifts; 2 percent for personal taxes and social security payments; and 2 percent for all other.

Nearly two-thirds (62 percent) of the families lived in houses classified as in good or medium condition, the remainder (38 percent) in houses classified as in poor condition. Eighty-seven percent of the families had electricity; 18 percent had water piped to the kitchen; 6 percent water piped to the bathroom.

The health of the great majority of husbands and wives in these families was rated good. Only 17 families mentioned a health problem.

At the time of the interview 82 percent of the families owned a radio or radio-phonograph; 39 percent a television set; 10 percent a record player and 3 percent a piano.

Religious organizations (such as church, Sunday School, missionary society) were those attended regularly or occasionally during the past year by most husbands and wives. Those not attending any organization regularly (25 husbands and

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[9] See footnote 3 for reference.

17 wives) often gave reasons such as "children too young", "too busy", "live too far from meetings", "not in habit", "no transportation", "need more clothes".

Seventy-one percent of the families increased debts or drew on assets to make funds available for family use. More used the installment plan and larger amounts were involved than for other forms of credit. These families went in debt or reduced assets for family expenses more than for farm expense.

Ninety-six percent of the families used some of their income to increase their assets and to decrease debts. Largest amounts were involved in payments on auto, truck or tractor (farm share) bought more than a year ago.

Taken as a whole the 100 families showed a net deficit of $81. Forty-three percent had net surpluses, 57 percent net deficits.

Long-time plans of the 100 families most often included improvements in their home and its equipment.

From data available from similar studies made in Mississippi during the thirties and forties it would seem that the young farm family of today has much higher levels of living. Two factors in this improvement seem to be (1) large shift of youth out of farming, including more off-farm opportunities for those who continue this career; (2) more assistance than formerly (in form of training, such as balanced farm and home planning, veterans' farm training, loans at low rate of interest, and the like) to those who choose farming as a career.

Implications

This study has implications for young Negro farm-operator families and for agriculturists, home economists and others who work with them.

A list of expenses for family living by similar farm families might be used by "my" family to check our expenses. For example, families in this study spent $1400 for family living. Our family spends about $1000. We might check reasons for differences. One reason may be a lower income. What can we do to raise our income? County agents and other agriculturists can give helpful suggestions. Another reason for the difference may be we spent less for food than do these families. A question here is: Is our food supply adequate? Do we eat mainly flour, syrup, rice, fatback, coffee? Are we carrying on more food production than this average family? Home agents and other home economists can help at this point.

This study points to the need for certain emphasis in educational programs directed towards young farm families. Some of these are:

(1) **An overall attack on low income.** Incomes are better, much better than were incomes of similar families in the latter thirties and forties, but there is still need for improvement. Higher incomes involve first of all a "remain in school" and "back to school" movement. Elementary education is basic background for most kinds of vocational training. More off-farm jobs need to be made available. For families who show interests and abilities in farming there is need for further training in techniques of farming and farm homemaking, such as in programs provided by balanced farm and home planning of the Extension Service. For many of these families there is need of assistance in increasing the scale of farm operation. There is a shortage of land and capital in relation to labor available.

(2) **Food buying.** These young farm-operator families spent relatively more for food than for any other type of consumer goods. It is important that both husband and wife know the foods needed for an adequate diet and what qualities to look for in making purchases of specified foods; that they re-examine the foods produced at home for family use.

(3) **Consumer credit.** Families need to know that credit is not a substitute for

income. Consumer credit is a way of spending money in advance of anticipated income. Families need to know that credit decreases their income by the cost of that credit which is interest charged for the use of money. The farm operator and homemaker need to agree on when and how such credit should be used. They should know how to figure costs of consumer credit and how to shop for it. Such information is essential in making wise decisions as to its use.

(4) **Greater participation in community organizations.** Participation in organizations of these young families seemed to be almost altogether limited to the church. Ways and means need to be developed whereby young farm families participate more in other organizations of the community.

APPENDIX TABLES

Table 1. Average income of young farm-operator families in five counties, Mississippi, 1957.

Type income	Coahoma	Jefferson Davis	Madison	Pontotoc	Winston
Net from farming ($)	495	749	208	392	542
Off-farm earnings ($)	471	489	1189	828	629
Other money income ($)	124	88	173	62	101
Total income ($)	1090	1326	1570	1282	1272
Percent with off-farm earnings	81	68	80	55	95
Percent with other money income	10	21	30	20	20
Number families	21	19	20	20	20

Table 2. Average net income family expenses and number families with a deficit and with a surplus and average amount of the deficit and of the surplus, young farm-operator families, 5 counties, Mississippi, 1957.

Item	Coahoma	Jefferson Davis	Madison	Pontotoc	Winston
Total income ($)	1090	1326	1570	1282	1272
Family expenses ($)	1655	1507	1694	1099	962
No. with deficit	15	14	12	8	9
Average amount for those with deficit ($)	826	344	505	228	136
Number with surplus	6	5	8	12	11
Av. amount for those with surplus ($)	83	349	452	461	677

Table 3. Percentage of young farm-operator families having expenses for specified family living items and average expense per family, 1957.

Item	Percent families having expense	Average expense per family
Food at home	100	402
Drinks, snacks away from home	86	19
School lunches	31	12
Other meals away from home	22	14
Vitamins and minerals	18	3
Clothing	100	182
Clothing services	90	20
Toilet articles	98	14
Barber and beauty parlor services	82	23
Rent, taxes,* insurance on house	9	5
Lodging away from home	10	10
Repairs and replacements on house	8	5
Gas, electricity, fuel, ice, telephone, etc.	100	84
Freezing supplies, rent of locker	16	2

(Continued on page 15)

Table 3. (Cont.) Percentage of young farm-operator families having expenses for specified family living items and average expense per family, 1957.

Laundry sent out	6	1
Wages for household help	1	***
Laundry, cleaning, and other supplies	100	26
Furnishings and household equipment	89	82
Auto** or truck operation	70	129
Auto** or truck purchase	19	60
Other travel	30	15
Medical care	94	58
Blue Cross and other health policies	25	19
Reading material	42	4
T. V., radio, piano	11	31
Dues to clubs, Farm Bureau	24	3
Repairs on recreational equipment	15	2
Paid admissions	45	4
Toys for children	74	17
Sports equipment	63	22
Education	72	16
Religion, gifts, community welfare	96	33
Tobacco	77	45
Income, poll, and other personal taxes	17	4
Social Security payments	42	24
Other family expenses	31	10

*Housing expenses were entered as family living expenses only when paid separate from farm expenses. Entry was made under farm expenses if paid with farm.

**Only family's share was charged as a farm expense. Thus, if car or truck was used 10,000 miles and one-half the mileage was for farm use and one-half for family use, then one-half of the operating expenses or payments was charged as family expenses and one-half as farm expense.

***Less than .50

Table 4. Percent of young farm-operator families using specified home-produced foods and fuel and average values per family of amounts used, 1957.

Item*	Percent families using	Average value** per family
		Dollars
Dairy products	67	108
Eggs	89	51
Poultry	84	18
Pork	86	71
Other meats	18	9
Fish, game, birds	72	10
Potatoes	86	29
Fresh tomatoes	86	12
Other fresh vegetables	99	242
Fresh fruits	89	19
Syrup	27	11
Cornmeal	67	34
Nuts	48	22
Popcorn	12	1
Tomatoes (canned)	64	3
Other fruits and vegetables (canned)	86	15
Pickles and relishes	55	1
Jellies and jams	52	2
Other fruits and vegetables (frozen)	16	5
Other fruits and vegetables (dried)	16	7
Total	100	670
Fuel (fire or stove wood)	83	160

*Includes foods obtained from woods, streams, fields.

**Home-produced foods eaten by the household in 1957 were valued at the price the farmer could have received for them if he had sold them. Prices compiled by the Marketing Service of the United States Department of Agriculture for Mississippi were used inasfar as possible. Where prices were not available and the food was sold locally, the most typical prices received by local farmers selling the same were used.

Table 5. Net change in assets and liabilities of 100 young farm-operator families in Mississippi during 1957.

Item	
Average net money income ($)	1307
Average expenditures for family living ($)	1400
Surplus*	
Percent of families	43
Average amount ($)	448
Deficit	
Percent of families	57
Average amount ($)	484
Average annual change in net worth** ($)	—81
Percent of income	6.2

*Changes resulting from actual money transactions.

**Negative amounts indicate a net deficit; positive amounts a net surplus; average change in assets and liabilities do not equal the exact difference between money income and money expense. In accepting a schedule an error of 10 percent of the income or expenditure, whichever was greater, was allowed.

Table 6. Goals of farm families for the next ten years.

Goals*	Percent
Major household equipment of specified kinds like home freezer, air conditioner, washing machine	42
New home, own home, better house, rebuild house	37
Own land, own farm, more land, buy land and relocate, pay for farm	15
Remodel house, add/rooms, add patio, another bedroom, etc.	7
New car, better car, another car	16
Add household furniture of specified kind as new furniture, bedroom suite, couch, chairs, tables, living room suite	11
Get a T.V., radio, record player, or piano	18
Farm equipment of specified kinds as tractor	9
Running water in house	11
Repair house such as painting, redecorating, papering, floors refinished	8
Add bathroom plumbing, add hot water heater	6
Making improvements as Grade A dairy, hog pasture, add livestock, clear new pasture, change breed of cattle, terracing work	8

*Other plans included complete or finish house, add farm buildings of specified kinds, have electricity, add minor household equipment as drapes, rugs, curtains, venetian blinds, to be a farm renter, landscaped lawn.

BULLETIN 581 JULY 1959

Relative Humidity In Cotton Fields At Harvest Time

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Mississippi State University
AGRICULTURAL EXPERIMENT STATION
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Conclusions

Relative humidity measurements in defoliated and undefoliated cotton at Stoneville, Mississippi, in 1958 indicate that leaf cover is one of the major factors influencing humidity in cotton fields. For instance, during an 18-day period from October 20 to November 7, relative humidities averaged 8.8 percent lower in defoliated than in undefoliated fields.

Previous investigations have shown that excess moisture creates problems in handling, cleaning, and ginning seed cotton. Other tests have revealed that atmospheric moisture greatly influences the moisture content of machine-picked seed cotton.

Therefore, the reduction of leaf cover can play an important part in reducing seed cotton moisture and preserving the quality of cotton fiber in humid areas.

From this study it is indicated that defoliation can increase the number of hours of safe picking in addition to its other beneficial effects.

RELATIVE HUMIDITY IN COTTON FIELDS AT HARVEST TIME

By J. A. RILEY[1] AND E. B. WILLIAMSON[2]

Delta Branch Experiment Station, Stoneville, Mississippi

Ever since agriculture began, farmers have been acutely aware of weather's primary control over crop growth and farm income. It has only been in the last few years, however, that scientific agriculture has shown that weather also controls many secondary phases of agriculture and crop value.

Relative humidity, through its effect on moisture content of seed cotton, is an important variable during the cotton harvest. Excessive moisture in the cotton causes a lowering of grade when the cotton is stored. Even when there is little or no delay in drying and ginning, cotton loads of different amounts of moisture are frequently lowered in value because of inadequate regulation of the dryers.

The Delta Branch Experiment Station and the Cotton Ginning Research Laboratory of Stoneville have studied the effect of relative humidity on the moisture content of seed cotton and the resultant effects on the grades of cotton. Results were summarized by O. B. Wooten and R. A. Montgomery in Mississippi Agricultural Experiment Station Circular 204, April 1956. They found that relative humidity was the greatest single control of moisture content in seed cotton, excluding actual rainfall. This investigation is an extension of one phase of that study and is an attempt to determine the variation of relative humidity within the cotton field.

How Does Relative Humidity Vary?

To understand how variation in relative humidity can affect cotton properties, it is first necessary to understand how relative humidity itself varies. Relative humidity is the ratio of the moisture content of the air to the moisture capacity; it is measured in percentage. A humidity of 50 percent means that the air is half full of water vapor; or, the air could hold twice as much water vapor as it is holding.

In cotton fields, both the moisture content of the air and the capacity vary. The capacity is largely controlled by the temperature of the air; that is, hot air can hold more water vapor than cold air. Most of the daily variation in relative humidity is due to the daily variation in temperature.

The moisture content of the air is the balance between incoming and outgoing water vapor. The air around cotton plants receives vapor from the transpiring plants, evaporation from moist soil, rainfall and from moist air moving northward over the area from the Gulf of Mexico. At night, the air frequently loses water vapor by dew formation, but this is usually returned during the following day. Vapor losses of more importance occur with rising air currents and with strong dry winds.

During the hours of darkness, moisture is often trapped in a shallow layer near the ground by a temperature inversion just above the ground. In the afternoon convection, or rising air currents, breaks through the inversion and spreads the moisture aloft through a deeper layer of air. Usually, the largest changes in moisture content of the air are caused by strong dry winds following a cool front through the area from the Northwest.

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Instruments and Field Conditions

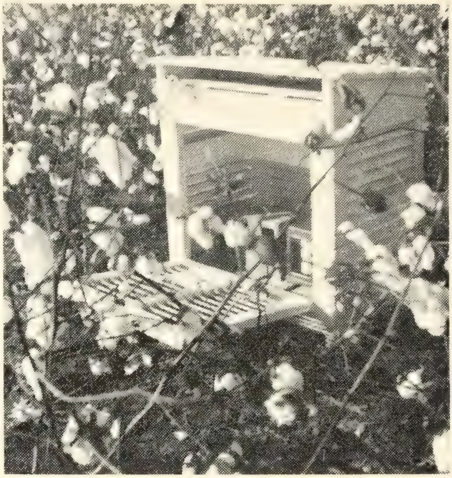
Two regular weather instrument shelters with two temperature and humidity recording instruments in each shelter were placed in the Station experimental fields; one in a well-defoliated plot and the other in a plot with fairly rank leaf cover. The recording elements were located about 8 inches above the ground. The plots were 20 rows wide and 800 feet long and were adjacent to larger fields of similar cotton.

The cotton plants averaged 5 feet high in both plots, and a heavy top crop of bolls, coupled with late-summer rainstorms, had caused some lodging. Very little natural leaf shedding had occurred prior to October 7, the date a liquid defoliant was applied. As shown in the picture, very little leaf cover remained in the defoliated field during the test period.

On November 7, frost occurred and began defoliating all fields. The process was gradual however. A week later on November 14, three-fourths of the leaf cover on the undefoliated field had dried out or fallen off. By the end of the period, both fields had about the same leaf cover. These three periods will be referred to in the rest of the report as: Before frost, October 20 - November 7; transition, November 8 - November 14; and after frost, November 15 - November 23.

How Much Does Relative Humidity Vary?

The relative humidity reached 100 percent on many nights throughout the experiment. The lowest humidity was 15 percent in the defoliated field and 24 percent in the undefoliated field and occurred November 11, 1958. The very dry weather was caused by a dry, cool high pressure system that moved southeast from western Canada. On the 11th, the center was over Kentucky, and the northeasterly winds from this high brought the dry air into the Delta.



Closeup view of shelters in defoliated (above) and undefoliated (below) cotton. Note hygrothermongraphs visible in shelter in defolated field.

During the first 18 days of the experiment, or before frost occurred, minimum relative humidities in the defoliated field averaged 8.8 percent lower than in the undefoliated field. Just after frost, and during the transition period, the difference was 7.7 percent. On the final portion, the difference dropped to only 1.6 percent, and most of that occurred early in the period.

Relative Humidity Less Than 50 Percent

Wooten and Montgomery found that after a morning dew a relative humidity of approximately 50 percent is the dividing line between cotton dry enough to pick and cotton that is too wet.

Table 1 shows the average daily number of hours that the humidity was less than 50 percent during the 35-day experiment. On 6 days the humidity did not drop to 50 percent, and these were not included in the averages shown in the table. The humidity in the defoliated field was less than 50 percent for an average of 7.6 hours and in the undefoliated field for 6.7 hours.

The defoliated field was dry enough for safe picking for about 1 hour longer than the undefoliated field. This increased the safe picking time a little more than 10 percent. The difference usually occurred early in the day; that is, the defoliated field dried out about an hour earlier in the morning than did the undefoliated field.

After the frost period, the difference in safe picking time dropped to only 0.2 hour. The crop in total number of hours of low humidity late in the season was a reflection of the approaching wet season in Mississippi. The important fact is that the difference in the two plots dropped, indicating that leaf cover is a major control.

The minimum relative humidity and the number of hours the relative humidity is below 50 percent give an idea of how dry the weather is each day. However, these humidity values are not the same. For example, on days when a minimum relative humidity of 40 percent occurred, the relative humidity stayed below 50 percent for a period ranging from 2½ to 8 hours. When the minimum relative humidity dropped to 20 percent, the time the humidity remained below 50 percent ranged from 7½ hours to nearly 13 hours per day.

Figure 2 shows the average relative humidity in the defoliated and undefoliated fields for the best 9 days during the first 18 days of the experiment. For these better picking days, the average time that the humidity dropped to 50 percent was 7:15 a.m. in the defoliated field and about an hour later in the undefoliated. The humidity rose to 50 percent about 4:20 p.m. in the undefoliated field and 4:42 p.m. in the defoliated field.

The effect of the humidity rising to 50 percent in the afternoon and evening has not been related as closely to safe picking conditions as has the morning fall of relative humidity to 50 percent. Time is needed for the moisture content in the seed cotton to adjust to the environmental relative humidity. As a result of this time lag, it is possible to pick safely after the humidity has risen to above 50 percent. The exact length of the additional picking time will of course depend on

Table 1. The average number of hours per day that the relative humidity was less than 50 percent from October 20, to November 28, 1958.

Period	Defoliated	Undefoliated	Difference
Before frost	7.6	6.7	0.9
Transition	7.7	6.7	1.0
After frost	4.3	4.1	0.2

Table 2. The average daily maximum and minimum temperature and the daily range in temperature in degrees Fahrenheit in defoliated and undefoliated cotton fields, October 20-November 25, 1958

Period	Defoliated			Undefoliated		
	Maximum	Minimum	Range	Maximum	Minimum	Range
Before frost	72.3	49.0	23.3	67.4	50.1	17.3
Transition	75.9	47.9	28.0	72.7	48.3	24.5
After frost	72.1	52.6	19.5	72.8	52.1	19.7

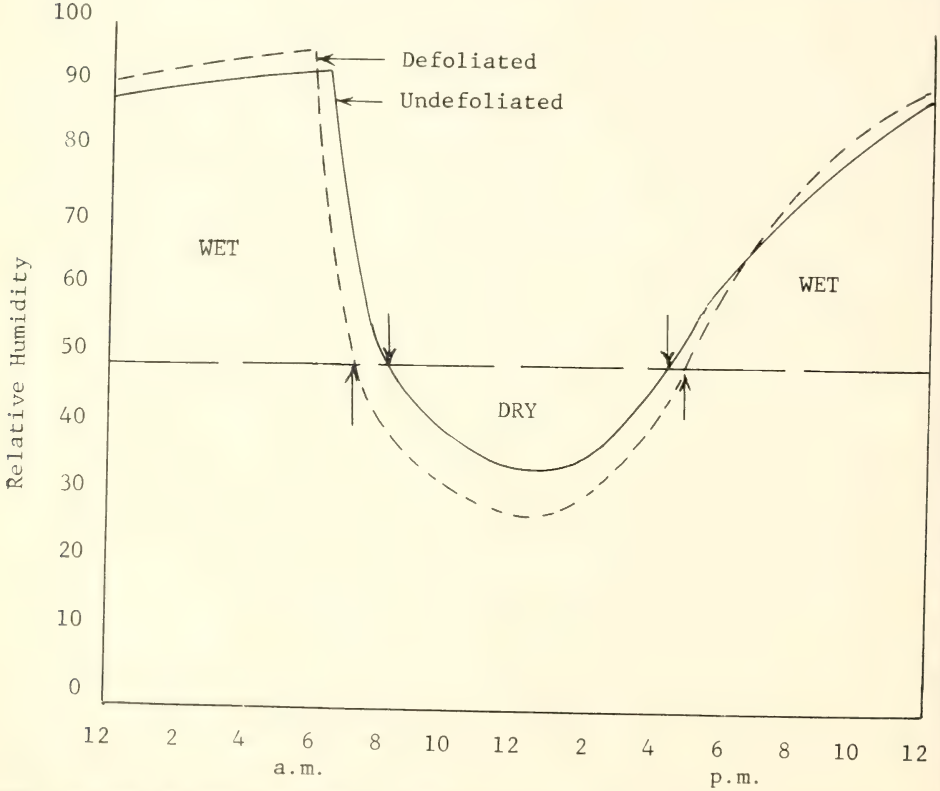
many conditions: the strength of the sunlight reaching the plant, the wind and the rate that the humidity rises, in addition to the facilities for handling and immediate ginning.

In regard to the indicated wet and dry periods in the graph in figure 2, it should be pointed out that the 1958 picking season was later than usual. This resulted in fewer hours of daylight and a reduction in the amount of good picking time. Investigations will be continued to determine the cutoff or end of the safe picking period.

Relative Humidity Greater Than 90 Percent

As the sun goes down, the temperature usually goes down and the humidity rises. In most seasons it is very rare that cotton fields do not become moist at night during harvest time. In fact, there were only 2 nights out of the entire 35 nights of record that the relative humidity failed to reach 90 percent.

The relative humidity can stay above 90 percent much longer than it can stay below 50 percent. In this study, the longest period that the humidity was below 50 percent was 13 hours. The humidity was above 90 percent for 37 consecutive hours from the evening of November 17 through the morning of November 19. This occurred in the defoliated field and was the result of light rain and drizzle



The average relative humidity in defoliated and undefoliated fields at Stoneville for the best 9 picking days during the 18-day period from October 20, 1958 through November 7, 1958. Of special interest is the fact that the defoliated field is drier than the undefoliated field in the daytime but the condition reverses at night.

that fell intermittently through the period.

It was shown earlier that the minimum relative humidity averaged 8.8 percent less in the defoliated field prior to the first frost. Also, the humidity was less than 50 percent for about an hour longer in the defoliated field. Both of these measurements indicate that defoliated cotton fields are drier in the daytime, the time of picking. During the first 18 days of the experiment, the period before frost, the relative humidity was above 90 percent for an average of 8.2 hours in the defoliated field and only 7.4 hours in the undefoliated. The defoliated field had a high humidity for an average of 0.8 hour longer. Thus the defoliated field was generally wetter than the undefoliated field at nighttime.

These measurements, daytime showing the defoliated field drier and nighttime showing it wetter, might appear contradictory until the causes of the change are considered. The absence of leaves in the defoliated field permitted freer circulation of air; also, the lack of leaf cover permitted the ground in the defoliated field to both heat and cool quicker and to a greater extreme than the field with rank leaf cover.

Temperature Range in the Cotton Fields

Since temperature variation plays a large role in the variation of relative humidity, it is interesting to see how readings in the two fields compare. Table 2 shows the average maximum, minimum and range in temperature in both fields. Before frost, the maximum temperature averaged almost 5°F. higher in the defoliated field and the minimum averaged 1°F. lower. Thus the temperature range was 6°F. greater in the defoliated field with the greatest difference occurring in the maximum temperature.

After frost, the difference in temperatures between the fields of different leaf cover is much reduced. This agrees with the data on relative humidity and indicates that the variation in temperature is quite similar to the variation in relative humidity in cotton fields of different leaf cover.

BULLETIN 582 SEPTEMBER 1959

Marketing Potential for

MISSISSIPPI CHRISTMAS TREES

With Special Reference To Arizona Cypress

By

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MISSISSIPPI STATE UNIVERSITY

Summary and Conclusions

Handlers of Christmas trees in Mississippi indicate that quality Mississippi grown trees are preferred. The necessity of ordering out-of-state trees as much as eleven months before Christmas, and the receipt of many poor quality trees in the shipments are highly undesirable.

Marketing channels for Mississippi grown Christmas trees are generally direct in small towns with farmers either selling their trees to the public or to the grocers. Christmas tree handlers in the larger towns and cities generally order from the northwestern states and Canada.

Since many Chistmas trees are being imported into Mississippi and none are being exported, it seems that Mississippi should attempt to produce more Christmas trees if possible.

Christmas trees in Mississippi are a farm crop which can be produced on odd shaped or poorly located tracts of land, can be handled in the farmer's off-seasons, and can be produced with a minimum of financial investment.

Species suited for growth in Mississippi as Christmas trees are eastern redcedar, southern pine, and Arizona cypress. Probably the best species with which to work further is Arizona cypress. This tree has been grown successfully by some land owners in Mississippi, and has found a ready market in small quantities.

Several definite problems concerning the growing of Arizona cypress remain to be solved in this area. If a seedling source can be found, the next problem is to get this delicate seedling to survive. With only a short time elapsing between seedling lifting and planting and with site preparation and weed control, this species has been found to survive very well. But with any one of the above mentioned items missing, survival can be expected to be poor.

Once survival is obtained, the trees must be pruned continually to produce a quality tree. Since only quality trees can be expected to be sold, this may be the difference between profit and loss.

When the trees are on the market for the first few years, they will probably sell as well as imported trees, but after being sold a few years, they will have to live up to expectations. This means that their disadvantages of having non-pliable branches in shipping, dryness of twigs if the base of the tree is not placed in water, and branches that will not hold up heavy ornaments and lights must be recognized and be accepted by the owners.

Even if this tree does not fill completely the bill of a perfect Christmas tree, it is quite possible that there will be a good market, for this tree has advantages of a fragrant aroma, beautiful blue-green color, dense, compact, symmetrical crown, and the ability to produce a Christmas tree in as few as three years.

This last advantage of quick growth may enable some persons to produce a more inexpensive local tree that will be preferred by many.

MARKETING POTENTIAL FOR MISSISSIPPI CHRISTMAS TREES

With Special Reference to Arizona Cypress

By **WILLIAM A. SHAIN**

Introduction

The Christmas tree industry might become one of considerable importance in many Southern states. Financial returns can be very good in relation to the amount of time expended. Actually, only about one month of the year need be spent in taking care of the trees, and this month is split into different seasons, one in the winter and the other in the summer. These are the times when the farmer is least concerned with other farm activities. Another favorable factor is that many farms have areas that are not well suited to crops; these areas may be good for the growing of Christmas trees and thus help the farmer get the best from each area on his farm.

Hundreds of thousands of Christmas trees are shipped into the South each year from the northern and western states and Canada. Several factors, however, limit the quality of these trees. First, they must be cut at least a month in advance of Christmas and stored in a cool, damp place until shipping time. If cutting is delayed, many trees may be completely covered with snow.

Another factor is transportation. Christmas trees are transported from Canada to the furthermost points of the United States. They must be handled at least twice as many times as home grown trees. It costs a minimum of twelve cents to transport a five-foot Christmas tree from Quebec, Canada, to Jackson, Mississippi. Yet Canada exports more Christmas trees to the United States than are grown in any single state.

Personal interviews with retail dealers indicate that the current method of procuring trees is not satisfactory. Trees must be ordered by early summer, many are received in such poor shape that they must be destroyed, and dealers often are not able to sell all the trees that they place on sale. In all cases the retailers said they would prefer to handle fresh, home grown trees if such trees were available and would sell.

Mississippi has one of the smallest and poorest Christmas tree industries of any state. The principal reason is that the South lacks a species wholly acceptable to the Christmas trade. Many people like the Eastern redcedar and some of the common pines, but these trees generally lack the quality of many of the other species. A good Chrismas tree must have appealing shape, color, aroma, and needle-holding capacity. If the South had a tree with all of these traits grown in sufficient numbers, she could reap the rewards of home grown products over products from other states and Canada.

Within the past few years, a species has been introduced to the South which has many of these favorable traits. This is Arizona cypress. In addition this species has the ability to grow into a suitable tree in as few as three years. In comparison it takes from seven to twelve years to grow Christmas trees of the same size further north.

Acceptance of this tree by the public is one of the biggest questions concerning this species. Results of a few small marketing experiments reveal that it sells very well, perhaps even on a par with species imported from the North. Further work must be done with the marketing of this species before it can be completely recommended.

Based on the national average of one Christmas tree for each 4.5 persons, it is estimated that over 480,000 trees may be used annually in Mississippi. Even if over half of these trees are not purchased, it is obvious that this is a sizeable industry. The potential market for Mississippi grown trees takes on even more importance when the nearness of Mississippi to several large out-of-state markets such as New Orleans, Memphis and Birmingham is realized.

Markets

Inquiries on the marketing of Christmas trees in Mississippi were made in 1957 and 1958. In several instances handlers complained of the poor quality trees which had to be ordered from six to eleven months ahead. One person claimed that 50 percent of his trees had to be culled because of foliage loss, broken branches and inadequate denseness. It seems that two orders of trees are often shipped on each boxcar, and the person who receives the boxcar first picks out the best trees and leaves the rest for the next purchaser.

Quality generally determines the number of trees sold on a lot. Some items affecting quality are as follows: pliable branches that allow a tree to be compressed for shipment and fluffed out at its destination; fragrant aroma; non-prickly needles; retention of needles; and a dense, compact, symmetrical crown. All these factors vary according to the species; however, the last two can be controlled to some extent.

Size preferences vary tremendously. Business establishments, schools and civic organizations favor trees that are too large to be placed in a home. These trees are generally purchased the first week in December, early in the Christmas season. Mississippi retailers relate that many of the families who purchase trees early in the season buy the largest trees. This usually means an 8-foot maximum height for homes.

Some people desire a small 2 to 3 foot table tree. Many of these smaller trees are sold late in the Christmas season just before Christmas, and the larger cities often sell a larger percentage of these smaller trees. Most persons, however, prefer a tree of intermediate size, and dealers say that from 5 to 7 feet is the preferred size range.

Marketing channels of most of the small towns in Mississippi are direct. The farmer cuts a truckload of Eastern redcedar and sells the trees on one of the main roads into town. Others sell their trees to grocers. Also, the grocer may simply order his trees from the wholesaler as he would his groceries.

The larger the city, the more complex the marketing channels. Along with the same channels that exist in a small town, there are a number of independent Christmas tree lots. These lots may be run by Boy Scouts, civic organizations, church groups, or private individuals. They may cut their own trees or obtain them from truckers, wholesalers, or farmers.

City lots have been selling more and more tinted trees. It is advantageous for the seller to paint some of his trees; he sometimes doubles the price otherwise obtainable. With trees that have good form but poor color, this act will make an excellent tree from an undesirable one. Another type of tree which has found some favor further north is a "flocked tree." This is a tree coated with finely ground cotton applied with an adhesive.

Some of the Christmas tree handlers have found limited success with small, live trees grown in pots. Thus purchasers can be assured of keeping a fresh tree throughout the season. Then, after the Christmas season, the tree can be planted in the yard as an ornamental.

Another method which has been tried with some success is growing Christmas trees on land not far from a large urban area and selling them on a "cut your own tree" basis, whereby a family can select their own tree and cut it. There is a minimum of money and time expended in handling the trees. Obviously this method requires provisions to prevent or minimize theft, but that is true of all aspects of the Christmas tree business.

Selling of Christmas trees will often have more to do with salesmanship than anything else. Examples in some northern states indicate that some of the lots with poorer wild-grown Canadian trees sold more trees than did those handling the native, plantation-grown trees of the same species.

It is quite possible that over forty million Christmas trees will be used in 1959. Probably over fifty million trees will be cut for sale. Someone must not only take a loss for the unsold trees but also the expenses of getting rid of them. The poorest quality trees will probably be unsold, and the buyer who ordered his trees the preceding January may be the man who is the loser. The prediction of the number of trees required in an area is a difficult one. It can only be answered in the South by having a nearby source of trees from which to supply only the amount of trees that can be sold.

Species

There are very few Southern species that are suitable for use as Christmas trees. Probably the best known and most used is eastern redcedar. This species grows naturally in practically all of Mississippi. It is found growing under a wide range of soil texture and moisture conditions, but planting should be avoided on light sands, heavy clays, and extremely dry soils because of its slow growth. Eastern redcedar does best on loam soils containing lime, but lime need not be present for satisfactory growth. It will hold its needles two weeks or longer when kept in a warm room. Several plantations observed by the author did not have good survival, and some that were well cared for received excellent survival. It takes about five years to produce Christmas trees of salable size.

Another species, Arizona cypress, looks very similar to eastern redcedar. It has the same type of needles, except they are not prickly and have a beautiful blue-green color and a fragrant aroma. At a given age the trees are taller and more slender than redcedar, and they have the ability to grow to Christmas tree size in as few as three years

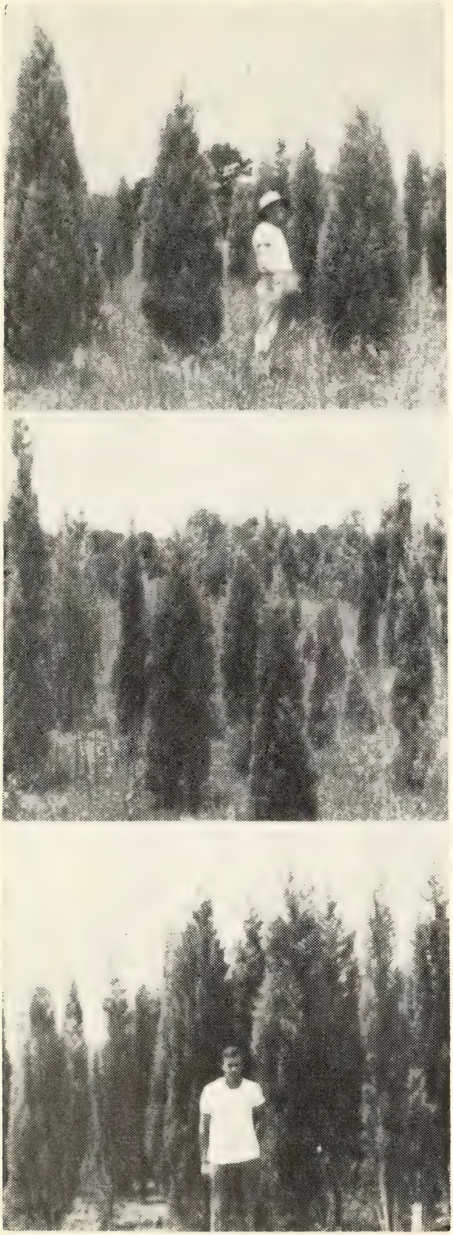
In a marketing study in Alabama (1) customer preference studies showed that five Arizona cypress were purchased for each redcedar. This could well indicate that Arizona cypress will be well received, expecially in an area which normally prefers eastern redcedar.

Management of Arizona Cypress

Site: Arizona cypress will probably grow best on the better soils, although for better natural Christmas trees it may be desirable to use poorer soil to obtain shorter, denser trees.

It has been determined (3) that the survival of Arizona cypress may depend principally upon the care given them. The first factor to consider is site preparation. This can be accomplished by plowing, discing, burning, or any of several ways to remove the initial competition of other vegetation.

Planting: Since Mississippi tree nurseries do not produce Arizona cypress for sale, the seedlings must be either grown by the individual from seed or obtained from out-of-state sources. These out-of-state seedlings will require a long period between the time of lifting the seedlings from the seedbed and the planting of these seedings. The author believes that the longer this period of time, the poorer will be the survival of the seedlings. For the planter to grow his own seedlings, on the other hand, would be the ideal way to obtain seedlings if it were not for the fact that this species



TOP. Good Arizona cypress trees with adequate fertilization and 6 x 6 foot spacing.
CENTER. Poor land and lack of fertilization.
BOTTOM. Trees too close together in this 4 x 4 foot spacing.

is extremely difficult to raise because of poor germination and disease.

This leaves us with a definite problem, whether to purchase expensive, out-of-state trees that will probably get poor survival or to attempt to grow our own seedlings. The only help in sight for the handling of seedlings would be the future production of these seedlings by local tree nurseries after production problems have been solved.

The initial planting is the only great problem, for subsequent trees can be secured by a branch left on the recently cut stump, a process to be explained later, called "stump culture."

Even though machine planting is often the only feasible way to plant on a large scale, there are several factors which hinder it. Since many Arizona cypress seedlings grow to a height of 24 inches or more in the seedbed and have equally long taproots they are hard to handle with any kind of planting tool and especially so with a planting machine. The optimum time to plant seedlings has long been recognized as being during a drizzling rain or soon thereafter. Wet conditions, particularly on clay soils and newly plowed fields, make the use of tractors and planting machines a difficult problem.

Competition Control: From observation of many plantations the author believes that lack of weed control is one of the greatest reasons for the failure of this species. Of the many people who have allowed their seedlings to be smothered by grass and weeds the first year, very few have any trees to show for their efforts.

Probably the best way to control weeds is to cultivate the land continually. This would require about 3 or 4 plowings annually depending on the amount of competition.

Sowing of some low growing cover crop such as inoculated crimson clover to help supply the needed nitrogen is recommended by some authors (1). This crop will reseed itself after the first year, and little care of the plantation will be required since the low growth will keep out competing weeds.

Another method of weed control is to cut the weeds with some type of lawn or hay mower. These low cut weeds will still compete with the tree for water and minerals, but the surival of the trees will be helped.

Several plantation owners control their weed problem by grazing animals on their land. Cattle and goats apparently do not feed on these trees as long as there is other suitable growth in the vicinity. Under these conditions a loss of less than 5 percent of the trees due to breakage by the moving animals can be expected.

Spacing is important. While a 4 x 4 spacing is quite often used, this is not recommended because the trees are hard to work with ordinary equipment. Equipment used to combat weeds may get too close and push the tree at an angle; thus when tree growth continues, a crooked, unsatisfactory tree is formed. A spacing of 6 x 6 feet allows plenty of room for tree growth and working the area. Another reason for the wider spacing is the possibility of having to wait until the fourth or fifth year before harvesting. In a spacing study at the Newton branch of the Mississippi Agricultural Experiment Station, the trees planted at spacings of less than 6 feet produced few suitable Christmas trees (2). These trees were harvested at six years of age.

Fertilizer: The kind and quantity should be the recommended type for that particular soil as verified by testing soil samples. Nitrogen has been shown to give a significantly higher growth rate. Growers who use fertilizer should realize that this is likely to increase the height growth thus requiring additional pruning.

Pruning: This phase of plantation management may be the difference between having a large profit or no profit at all in the venture. Arizona cypress naturally grows tall and columnar, but can be pruned into almost any shape that is desired.

During the first growing season, only a few trees shoot upward abnormally into a narrow crown, and they can be safely pruned during the first winter after planting. The rest of the trees should be allowed to get as much height growth as possible during the first growing season. In the second year more of the trees show a tendency to accelerate their height growth.

There are two general types of pruning, annual and continued. Annual pruning will accomplish much with many trees that would otherwise be unsalable but will not produce many exceptionally fine Christmas trees. It is done by shearing the trees only once or twice a year. The top is cut back from 6 to 18 inches depending on the rate of growth with a general shaping being done at this time also. With the main leader gone, several branches may try to assume a dominant position giving a tree with a fairly good shape but no single, strong leader on which the top ornament can be placed at Christmas. Here is the big disadvantage of this type of pruning.

Continued pruning, or pruning continually throughout the growing season overcomes this disadvantage. A person visiting the trees biweekly or monthly can select the best leader and slow down the other branches by clipping off the ends. By doing this, the trees will never be allowed to get out of shape, and the shearing will be confined to the succulent, green ends of the branches. These light prunings in the new, green growth will not seriously affect the appearance of the tree as will normal pruning practices.

If the trees get too large for Christmas trees, which can easily happen to an unpruned stand of trees, the 6-foot top of a 12-foot tree will often be a very nicely formed tree.

Stump Culture: When cutting the trees for harvest, the proper tool to use is some type of saw. From the whorl of branches at the top of the stump one or preferable two of the sturdiest branches should be saved with the rest of the growth removed down about 6 inches from these selected branches. The following year the branch which makes the best start should be selected for the final product in the next crop and the other removed. By this method more than one crop of trees can be obtained from the same original seedling.

The second crop of trees from the first crop's stumps will make remarkably good growth, especially in height, but will have to be heavily pruned to obtain the desired shape. It is possible to obtain other trees after the second has been cut.

Harvesting: Although the normal rotation for Arizona cypress is three years, there will be many trees that are too small to be cut at this time. Also, other trees will be too tall and narrow for sale. In either case some trees must be left for at least one additional year's growth. Thus a clearcut harvesting method is out of the question.

It might be a good idea to attempt to sell some of the boughs, for the fragrant aroma and pleasing appearance should place this foliage in high demand as decoration material.

Plantation Protection: Fire is probably the first item to consider in the protection of a plantation. Firebreaks reduce the danger; however, cultivating the land provides immunity from the threat of fires and is little more trouble than plowing firebreaks.

Christmas trees planted near a road may be cut by unauthorized persons. This problem can be reduced by planting the trees in a field not readily accessible to the poachers.

Little information is available on disease and insects of Arizona cypress. Two insects, the pales weevil and the evergreen bagworm, and one disease, juniper blight or phomopsis blight, are definitely known to affect Arizona cypress, with some plantations being affected to a great extent.

Bagworm damage.

The pales weevil is responsible for the disfigurement of many trees. It is a large weevil, similar to the cotton boll weevil, that feeds on the bark of the Arizona cypress. Symptoms are wounds, from which sap exudes, on the bark of stems and branches of the trees where the insect has been feeding. Often the branches will die from the attacks, and many trees are stunted in height. In order to control heavy attacks of this weevil, benzene hexachloride can be dusted on the affected portions of the plantation.

An insect which has infested plantations on a small scale is the evergreen bagworm. It can deform and kill individual trees and has been known to ruin a complete stand of trees. Work at Mississippi State University so far indicates that control would include spraying with Guthion.

Phomopsis blight is the most prominent disease that attacks Arizona cypress plantings. It is a disease that starts in the bottom branches and works upward, killing all the branches as it moves.

Costs and Returns of Arizona Cypress: Following is an estimate of costs and returns involved in growing Arizona cypress in Mississippi.

Area	One acre
Cycle	Four years
Land value	$ 40.00
Spacing	6 by 6 feet
Costs per acre:	
1210 seedlings at $15.00 per thousand	18.15
Labor for hand planting—2 men at 5.00 per day to plant 1000 seedlings	12.10
Cultivation - four years at $8.00 annually	32.00
Fertilizer—500 pounds per year at $2.25 per hundred pounds	45.00
Pruning and shaping trees—second through fourth year at $25.00 per year	75.00
Taxes for 4 years at $00.4675 per year	1.87[1]
Total cash outlay for the entire crop	$224.12
Total cash outlay for each tree (800 trees)	00.28
Returns:	
800 crop trees for sale at 1.00 per tree	$800.00
Net return on the tree crop	575.88
Net return for each tree (800 trees)	000.72

[1] Average tax rate on cultivatable land in Oktibbeha County, Mississippi.

Using this data, the possibilities of excellent profits can be seen. And yet, on almost any item, the costs shown are the highest likely rather than the normal. Land values may be cheaper than $40 per acre, machine planting cuts down on expenses, a four-year cycle is not normally required, most sites will not require fertilization, and with the proper care more than 800 trees per acre may be harvested. The actual investment may be neglible if a person does his own work in his spare time. In fact a farmer who owns his own land and equipment may figure his investment in money to be only the cost of seedlings.

Several persons have gone into this venture with huge profits in mind but nothing to show for their investment because they failed to care for their plantations properly. Caution should be used in attempting to grow Arizona cypress on a large scale.

Problems of Arizona Cypress: Probably the most discouraging item which prospective Arizona cypress owners must face is the lack of seedlings. In the past three years the Mississippi State tree nurseries have lost so many seedlings due to disease that they have discontinued their production except on an experimental basis. This species, however, can be obtained from private out-of-state nurseries at increased, although not extremely high, prices.

The next problem is to obtain the proper survival of the seedlings planted. Should the time interval between lifting the seedlings from the seedbed and the subsequent planting be too long, the survival can be expected to decrease. This species is not so hardy as Southern pine and cannot be handled as such. Only those people who prepare the site before planting and keep out the competition can be expected to get a decent percentage of their seedlings to live through the first year.

If a plantation survives the first year, the owner can then expect to place quality trees on the market only if the majority of his trees are pruned continually. There is little market for most tall, slender Arizona cypress trees, but there is a good market for well-formed, quality trees.

When these trees are ready to market, other disadvantages become evident. First of all, the tree does not have pliable branches that spring back out after being compressed in shipment. Trees that are packed on a truck for more than 24 hours will have two flat sides (4). This means that the trees must be cut, loaded, and transported to the selling place in less than one day's time. Once at the selling place, they must not be piled on top of each other, but each one must be stood up as a separate tree. Only a person who handles his trees in this manner will display quality trees for sale.

Once the tree is in the home, the family will find other things wrong. The branches are not quite strong enough for the heaviest ornaments and lights and will droop badly if these ornaments are placed near the ends; however, a good job of decorating which places the heavier ornaments closer to the trunk and the lighter decorations toward the ends of the branches may enable this tree to be made into a very beautiful Christmas tree.

Unless the tree is kept with its base in water it will dry out fairly rapidly in a heated room. Even though this does not cause the tree to shed its needles, it does become brittle and loses some of its desirable color.

This species does a good deal of growing late in the fall. If there is much warm weather in late November just before the Christmas season, the tree will produce some succulent, green growth that will turn brown if followed by a hard frost (4).

These disadvantages of Arizona cypress should be considered by anyone who desires to grow this species for Christmas trees.

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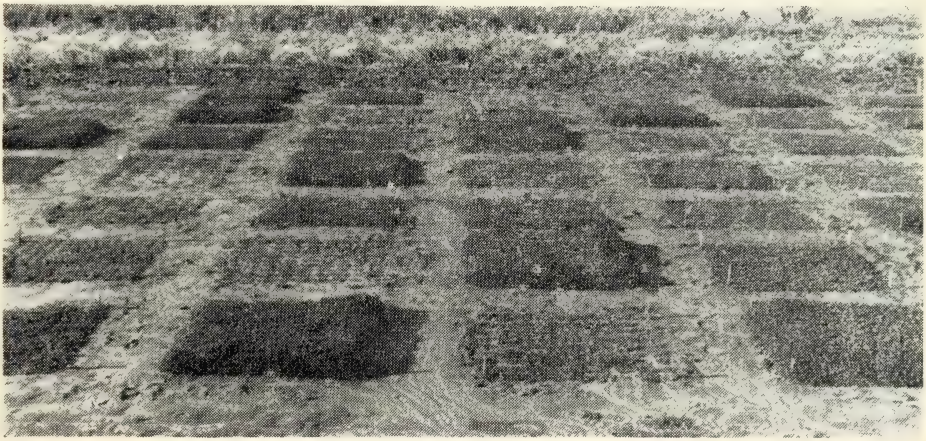
BULLETIN 583 SEPTEMBER 1959

The Effect of THICKNESS OF STAND



On Distribution of Yield and Seed Production of CRIMSON CLOVER

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The Effect of Thickness of Stand On Distribution of Yield and Seed Production of Crimson Clover

By W. E. KNIGHT[1]

A new concept in forage crop management has been under investigation at the Mississippi Experiment Station for five years. This research, in cooperation with the Crops Research Division, U. S.-D.A., showed that dense stands of crimson clover produced earlier fall and winter growth and much greater yields of high quality forage than thin stands.

Crimson clover, **(Trifolium incarnatum L)** is the most versatile and widely adapted winter annual legume crop of the southern region and is extensively used in the coastal section of the western states. It is a soil building crop and does well when grown with annual and perennial grasses and with small grains. For winter and early spring pastures, crimson clover is outstanding in total production of high quality forage. Good yields of seed provide another source of cash farm income.

Few experiments have been reported in which seedling rates of forage crops have been studied in conjunction with factors of the environment. Basic information is needed on management of crimson clover so as to obtain adequate stands and subsequent high yields of forage and seed, and to delineate physiological and ecological interactions essential to its improvement.

It was the purpose of this investigation to study the effects of stand density of crimson clover on physiological and morphological characteristics of the crop, on forage and seed production, and on the incidence of disease.

This investigation, begun in the fall of 1953, has been in progress five years. Dixie crimson clover was grown in square yard field plots in a latin square design. Plantings were made to the edges of the plots. Alleys, two feet wide, were left between plots to facilitate taking records. Plots and alleys were kept free of weeds. Entire plots were harvested for yields. Acre yield calculations are based on a square yard area, plus one-half the distance between plants added to each dimension of the plot. Planting was made the third week in September each year on Leeper fine sandy loam. This soil is reddish brown in color, well drained, and considered an excellent soil for crimson clover.

In 1953, six spacings were used as follows: 3/4, 1½, 3, 6, 12, and 18 inches. In 1954, a 9-inch and a 15-inch spacing were included with those above. The planting plan was altered in 1955 based on the results from the first two seasons. Additional spacings of 1, 2 and 4½ inches were used to provide more continuous data on the relationship of stand density to early growth, and the spacings greater than 6-inches were omitted. This provided a range in number of plants per plot from 2401 for the 3/4-inch spacing down to 49 plants per plot for the 6-inch spacing and a range in calculated seeding rate from 79.6 to 1.2 pounds of seed per acre, respectively. Figure 1 shows the plots after establishment and illustrates the experimental layout. (See cover.)

The plots were prepared, seeded, and watered by hand to promote establishment and maintenance of stands. The stands were thinned while the seedlings were in the unifoliate stage of growth. All blank spaces were reseeded and additional water was applied until the stands were fully established. Watering was continued for approximately 2 to 3 weeks

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[1] Research agronomist, Crops Research Division, USDA, and Mississippi Agricultural Experiment Station.

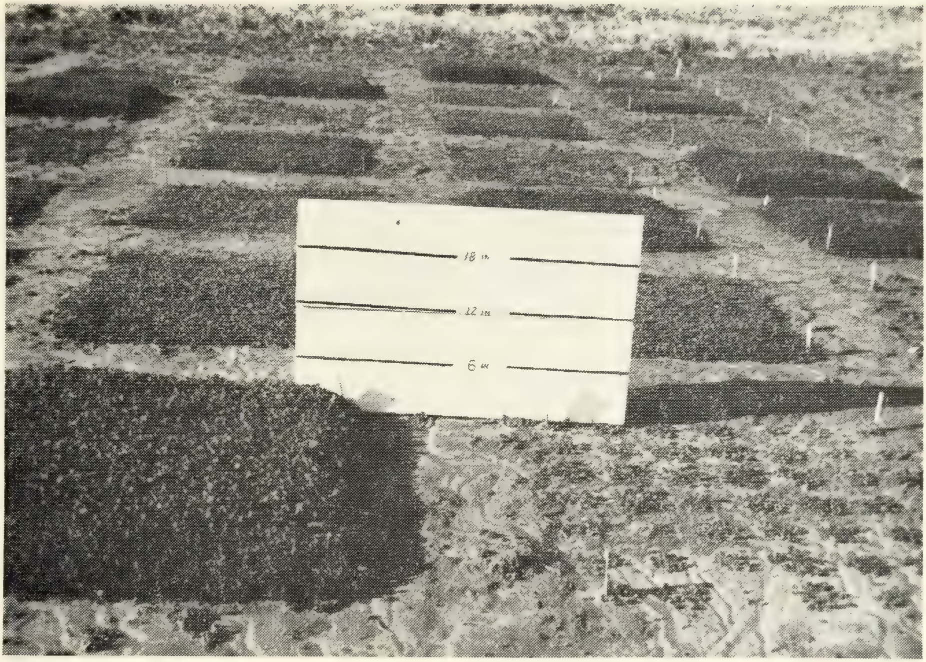

Figure 2. Comparative growth of crimson clover on November 27, 1956 in spacings of 3/4 inch left, and 6 inches right.

after the first seeding. An excess of inoculum was applied with the water after the stands were established to insure thorough and uniform inoculation.

Height, number of vegetative stems, number of seed heads per plant, number of florets per head, and forage yield were measured at full bloom. In addition to these measurements, periodic soil temperature readings were taken in the upper one-half inch of soil beginning with the 1954-55 growing season on selected critical dates, when the minimum air temperatures were low and high. Height measurements were also taken periodically during the growing seasons of 1955-56, 1956-57; and 1957-58. After December 26, 1955, soil temperature, in the upper one-half inch of soil, was recorded by soil thermographs placed in a 3/4-, 2-, and 6-inch spacing. Seed yields were taken in 1956, 1957, and 1958.

Clipping treatments were used during the 1956-57 seasons to determine the effect of forage removal upon the disease caused by **Sclerotinia trifoliorum** Ericks, and to provide a quantitative measure of yield distribution. The plots were clipped when the clover reached a height of 6 inches, leaving a 3-inch stubble.

Results and Discussion

Every year there was a close relationship between stand density and the rate of growth. On November 29, 1955, the clover grown at the 3/4-inch spacing averaged more than 7 times the height of that at the 6-inch spacing on the same date. Typical differences in fall growth of crimson clover grown in various spacings are shown in Figure 2. The plants spaced 3/4 inch had made 6 inches of growth and were ready for clipping on November 5, 1956, whereas, the plants at the 6-inch spacing did not reach 6 inches until February.

Forage yields taken in the full bloom stage did not provide an adequate indication of the differences in early growth and yield distribution. The distribution of forage production measured by clipping treatments initiated in the fall of 1956 is shown in Table 1. Dense stands of crimson clover produced high quality forage in the fall when green forage is usually in short supply. For example, the clover at the 3/4-inch spacing produced an average of 10,634 pounds of green forage per acre on December 5, 1956, with a dry matter content of 18.3%, while a somewhat similar yield for 6-inch spacing did not occur until March 1.

Clipping during the growing season reduced total forage production by an average of 609 pounds of dry matter per acre. However, the forage from the clipped plots was of high quality, being composed largely of leaves and fine stems. Forage from the plots which were not clipped during the growing season was of poor quality containing a large number of coarse stems.

Yields of dry forage varied widely with seasonal differences (Table 2). In 1953-54 forage yield increased as stand density increased, however differences between the 3/4-, 1 1/2- and 3-inch spacings were not significant. The damage from the March 25, 1955, freeze prevented a similar comparison for 1954-55. The yield data for 1955-56 indicates an increase in yield with stand density through the 2-inch spacing but shows a breakdown of the trend for the 3/4-, 1- and 1 1/2-inch spacings. Mules grazed these treatments on January 1, 1956. The widely spaced plants had insufficient growth for grazing at this time and the total yields for the closely spaced plants were biased downward.

Seed yields are presented in Tables 1 and 2. In 1956-57 and in 1957-58 severe lodging occurred before the plants were in full bloom and this condition apparently caused poor pollination and lower seed yields than in 1955-56. The 1955-56 crop lodged also, but lodging occurred

Table 1. Average yields of forage and seed from crimson clover at various spacings. Forage clipped at 3 inches when 6 inches high.

1956 - 57

Spacing	Dates of clipping and dry forage per acre							
	Dec. 5 1956	Dec. 17 1956	Feb. 4 1957	Feb. 12 1957	Feb. 21 1957	Apr. 26 1957	Season Total	Seed
in.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
3/4	1904			2601		8173	12,678	360
1	2062			3345		6873	12,280	504
1 1/2		1918			1784	9859	13,561	491
2			3432			9237	12,669	457
3				2969		6598	9,567	227
4 1/2					1377	6883	8,260	294
6					1280	5867	7,147	267
L.S.D. 5%							2,710	
C. V.							8.9%	

1957 - 58

	Dates of clipping and dry forage per acre						
	March 10 1958	March 20 1958	March 27 1958	April 3 1958	April 24 1958	Season Total	Seed
in.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
3/4	2717				7895	10,612	656
1	2830				8996	11,776	489
1 1/2	2554				7807	10,361	825
2		2717			7129	9,841	593
3			1523		7722	9,245	813
4 1/2			803		6067	6,870	796
6				1049	4279	5,228	732
L.S.D. 5%						1,385	
C. V.						10.2%	

after the bloom stage of growth and seed yields were not affected. Clipping the forage during the growing season, in 1956-57, reduced seed yields by an

Table 2. Plant characteristics of crimson clover grown at various spacings for 4 years.

Spacing	Height at Maturity	Seed heads/ plant	Florets/ head	Vegetative stems/ plant	Dry forage	Seed
in.	in.	no.	no.	no.	lbs./A.	lbs./A.
			1953-54			
3/4	31.4	1.0		1.4	7102	
1 1/2	34.3	1.7		2.2	6119	
3	30.9	5.2		6.3	5473	
6	26.0	8.1		7.0	2831	
12	21.7	8.5		8.2	642	
18	20.7	6.5		5.5	347	
LSD 5%	3.31	4.9		1.4	819	
C. V.	12%	36%		26%	20%	
			1954-55			
3/4*	------	------	------	------	------	
1 1/2*	------	------	------	------	------	
3*	26.2	10.2	52	10.0	7185	
6	25.1	26.8	81	25.8	6860	
9	26.3	52.3	74	34.4	5506	
12	23.4	52.1	79	25.8	4252	
15	22.3	68.1	83	32.6	2762	
18	21.1	58.9	80	27.3	2515	
LSD 5%	2.61	15.6	18	9.3	1100	
C.V.	12%	18%	25%	19%	18%	
			1955-56			
3/4	27.0	1.0	82	1.6	12,589	1370
1	28.0	1.7	83	2.4	13,437	1352
1 1/2	29.8	2.4	101	2.7	12,454	1731
2	31.2	2.7	100	4.1	13,271	1439
3	32.6	6.9	106	9.9	11,653	1491
4 1/2	31.2	11.5	120	16.5	9,946	1440
6	32.0	13.1	116	16.3	8,576	1528
LSD 5%	2.7	1.7	7	1.6	1,510	NS
C. V.	8%	22%	11%	18%	10%	7%
			1956-57			
3/4	29.8	1.4	94	1.6	14,396	404
1	29.0	2.3	88	2.5	11,956	667
1 1/2	33.8	2.4	90	3.2	12,625	536
2	33.6	3.5	89	4.6	13,643	507
3	30.8	7.6	98	8.9	11,259	258
4 1/2	33.4	11.9	111	16.4	8,260	478
6	33.0	15.0	98	25.8	8,285	287
LSD 5%	NS	1.92	NS	1.63	1,694	
C. V.	10%	25%	13%	14%	11%	
			1957-58			
3/4	27.8	1.0	85	1.5	10,612	656
1	28.5	1.0	112	2.0	11,776	489
1 1/2	26.8	1.5	111	2.8	10,361	825
2	29.0	2.8	118	4.3	9,841	593
3	31.3	5.3	120	8.5	9,245	813
4 1/2	29.0	9.5	120	15.3	6,870	796
6	28.6	17.0	131	20.5	5,228	732
LSD 5%	NS	2.48	23.3	2.55	1,385	
C. V.	10%	23%	13%	18.3%	10.2%	

*Plants spaced 3/4 and 1 1/2 inches were killed and the plants spaced 3 inches were damaged by a freeze on March 25, 1955.

average of 89 pounds per acre.

The marked effect of stand density on the number of vegetative stems and the number of seed heads produced by crimson clover is evident in the summary of measurement of plant characteristics (Table 2). Seed heads per plant averaged 1.1 and 15.7 for the 3/4-and 6-inch spacing treatments, respectively, and stems per plant averaged 1.5 and 18.7 for the same treatments. The ability of crimson clover to compensate for thin stands by branching is clearly shown by the number of vegetative stems per plant. The large number of seed heads produced as a result of branching could be very important in the establishment year of a re-seeding variety. Branching to compensate for thin stands may not be too important from the standpoint of forage production since the growth from thin stands always occurred late in the growing season.

Flower stems were always initiated earlier in the dense stands and resulted in slightly earlier blooming. The plants in the thickly seeded plots shown in Figure 3 were in the late bud stage of maturity in early March 1955, whereas, the plants in the thinly seeded plots were vegetative.

Height at maturity and number of florets per head were less affected by stand density than were the numbers of stems and numbers of seed heads. Seasonal variations apparently affected by these characteristics as much as did stand density.

Height measurements, used as an indication of fall growth of crimson clover grown in various spacings, are summarized in Tables 3 and 4. In some instances, the height of plants was lower than for the preceding date due to freezing of the upper leaves. The tendency of crimson clover plants to grow prostrate until leaves of adjacent plants touch is indicated by these height measurements. Therefore, some of the measured differences in height are a direct result of stand density or plant competition.

Surface soil temperatures under the various spacings was another factor contributing to growth differences of crimson clover. The typical soil temperature readings summarized in Table 3 show that the dense stands had a temperature advantage over widely spaced plants. This difference was sufficient to prevent ice crystals from forming in the surface of the soil under these stands, when the air temperature was below freezing and the ground was frozen under the wide spacings. Average minimum temperature readings presented in Table 4 follow the same trend but the averages do not reveal the differences that existed on critical dates when the air temperature was low. In general, minimum temperature readings were higher and the maximum temperature readings were lower under the dense stands than under the thin stands. The lower maximum temperatures under thick stands undoubtedly conserved moisture, particularly in the fall. Soil temperature differences probably accounted for much of the difference in early growth, however, plant competition has been mentioned as one of the factors controlling early growth.

Crown rot **(Sclerotinia trifoliorum)** caused extensive damage to the dense stands each year, except 1953-54. The greatest damage from rot occurred in February and March of 1955. The thick stands were particularly affected with no apparent damage to the stands in spacings greater than 3 inches. Clipping the forage during the growing season of 1956-57 gave good control of crown rot. The plants in the clipped plots were not killed although the disease was present. Typical areas of dead plants were common in the thick stands which were not clipped.

Wide variations in weather occurred during the 4 years of this experiment with extremely dry fall weather prevailing during the first 2 years. High temperatures and drying winds apparently reduced the efficiency of the water applied since the established plants made very little growth until rain occurred. Fall moisture conditions were good during the fourth and fifth years of this test and excellent fall growth was produced. The plants in spacings greater than 3 inches were severely damaged by heaving during November and December 1953, but no evidence of heaving was observed in the 3/4-inch spacing. The relatively large coefficients of variation for the 1953-54 data are caused by the varying degrees of damage from heaving (Table 2).

An unseasonal freeze on March 25, 1955, killed the plants spaced 3/4 and 1 1/2 inches and severely damaged the plants spaced 3 inches. Cold injury to plants in the remaining treatments was confined to the outer leaves since these plants were vegetative and had not initiated flower stems as had the closely spaced plants (Figure 3). Weather conditions during the late fall and winter of 1955-56 and the fall and winter of 1956-57 were much more favorable for growth of crimson clover than in the two previous growing seasons. Dense stands produced earlier fall growth measured by height and forage yields under both favorable weather conditions.

Results

Results of this research can be applied in the management of volunteer or reseeding stands of crimson clover. Areas of reseeding clover can be fertilized and disked in late August. If necessary and available, supplementary water can be applied to obtain early stands. A good crop of seed from a reseeding variety will assure the presence of adequate seed to provide a dense stand. Early establishment of a dense stand of crimson clover should provide grazing in November with normal rainfall. Protection from grass worms will be necessary, if an infestation occurs to avoid loss of the stand.

Every year, clover in dense stands produced earlier fall and winter growth and greater forage yields than that in thin stands. On November 29, 1955, the clover in the 3/4-inch spacing averaged 5.14 inches in height, whereas, that at the 6-inch spacing averaged 0.7 inch. On December 5, 1956, the clover at a 3/4-inch spacing produced an average of 10,634 pounds of green matter per acre with

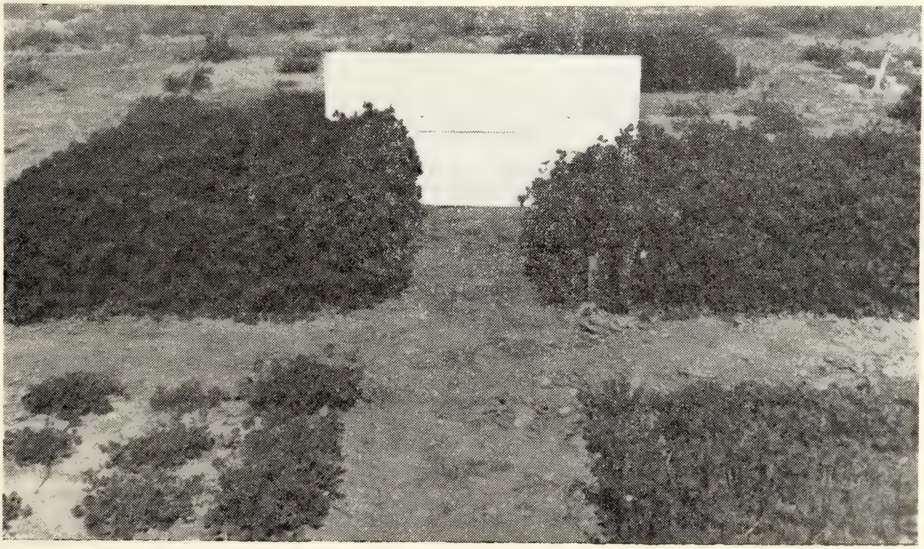

Figure 3. Growth of crimson clover on March 6, 1955, in a 3/4 inch and 1/2 inch spacing from left to right in the background, and a 9-inch and a 6-inch spacing from left to right in the foreground.

a dry matter content of 18.3 percent, while a somewhat similar yield for 6-inch spacing did not occur until March 1.

Stand density had a marked effect on the number of vegetative stems and the number of seed heads produced by crimson clover. Seed heads per plant average 1.1 and 15.7 for the 3/4 - and 6-inch spacings, respectively, and stems per plant averaged 1.5 and 18.7 for the same treatments. Seasonal variation apparently affected height at maturity and number of florets per head as much as did stand density.

In general, an increase in stand density produced an increase in total forage yield. In 1955-56, the clover at 3/4-inch spacing averaged 4,013 pounds of dry matter per acre more and 158 pounds of seed per acre less than at the 6-inch spacing.

Dense stands of crimson clover were damaged by disease when the forage was not clipped. In 1956-57, clipping the forage controlled the disease during the growing season. Total dry forage yields were reduced an average of 609 pounds per acre by clipping and seed yields were reduced an average of 89 pounds per acre. Forage from the clipped plots was of much higher quality than that from the unclipped plots.

Table 3. Soil temperatures on selected dates and plant height of crimson clover at various spacings, 1955.

	Soil temperature, 8-8:30 a.m. and date of measurement				Soil temperature and height, Nov. 29, 1955		
Spacing	Jan. 26 1955	Jan. 28 1955	Feb. 12 1955	Feb. 26 1955	Spacing	Height	Temperature
in.	°F.	°F.	°F.	°F.	in.	in.	°F.
3/4	34.2	34.4	32.8	46.8	3/4	5.14	36.1
1 1/2	34.8	33.2	32.4	47.2	1	4.86	34.9
3	31.6	30.0	30.0	48.6	1 1/2	3.50	32.3
6	30.2	30.0	29.0	50.2	2	2.18	29.9
9	30.0	29.8	29.0	50.4	3	1.36	28.9
12	30.6	29.8	28.8	49.8	4 1/2	0.79	28.7
15	30.0	29.8	29.0	50.0	6	0.71	28.6
18	30.0	29.8	29.2	50.8	......	......	......
36	30.0	30.0	29.2	50.6	......	......	......
Minimum air temperature	26.0	21.0	21.0	46.0	......	......	21.0

Table 4. Minimum and maximum soil temperatures under crimson clover at different spacings and clover height, 1956-57.

	Height of plants and soil temperatures measured in the upper 1/2 inch of soil								
Dates of obser-vations	3/4 inch spacing			2 inch spacing			6 inch spacing		
	Height	Temp.* min.	Temp.* max.	Height	Temp.* min.	Temp.* max.	Height	Temp.* min.	Temp.* max.
	in.	°F.	°F.	in.	°F.	°F.	in.	°F.	°F.
1956-57									
Oct. 25	3.6	61	73	1.6	59	79	1.3	62	84
Nov. 5	6.9	62	71	2.3	57	81	0.9	57	83
Nov. 12	7.4	56	62	2.5	51	62	0.9	50	71
Dec. 5	7.8	45	53	4.1	43	52	1.8	42	63
Dec. 17	8.0	56	61	5.0	53	60	2.0	56	69
Jan. 7	8.2	54	58	6.6	48	53	2.6	50	61
Jan. 29	8.3	54	59	7.0	44	50	2.8	46	55
Feb. 4	8.3	63	66	8.0	52	57	4.1	56	64
Feb. 12	9.8	67	71	10.0	57	61	7.0	61	69
Feb. 21	9.0	55	61	10.5	45	51	6.5	49	57

*Average temperatures recorded with soil thermographs since previous measurements.

BULLETIN 584 **OCTOBER 1959**

Washington County Soils

By

H. B. VANDERFORD

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

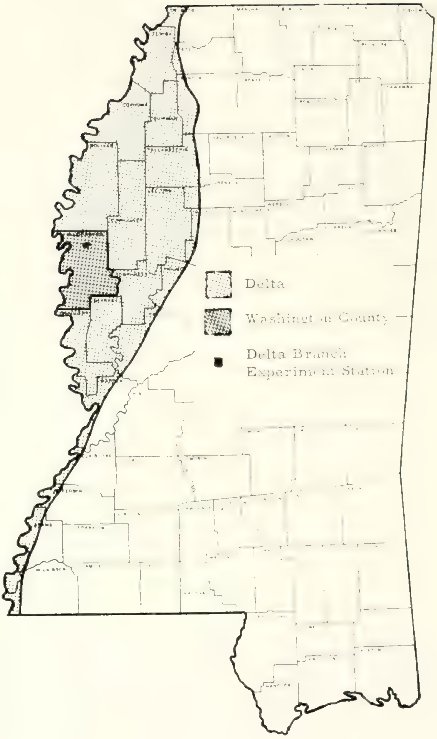

Figure 1. Map showing location of Delta, Washington County and the Delta Branch Experiment Station located in Washington County.

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ON THE COVER: The Delta Branch Experiment Station with many research projects and activities provides research information for the planters and operators of the Delta area. (*Courtesy of Mississippi Agricultural Extension Service*)

Washington County Soils

By

*H. B. VANDERFORD**

Productive soils provide our nation with the basic necessities of life and the crop and livestock products which are conducive to greater prosperity. Good soil is our most valuable resource. The more man learns how to properly use each soil according to its special behavior and adaptation the more certain agricultural people will be of success.

This publication is designed to help each land owner or operator to get the most from his soils and at the same time conserve them for they will be important to the welfare of future generations. This publication deals with soils on your farm and the other farms within Washington County. We know that you have a personal interest in your soils and are concerned about the best methods of management to follow in obtaining the greatest production on every acre of land. Therefore get a soil map of your land and determine the best use and management for each field. This will increase income and contribute to success on all farms in the county.

General Nature of Soils

Washington County lies in the River Flood Plain Region of the South and is a part of the fertile Mississippi Delta Area in Mississippi. The county is made up of 728 square miles or 465,920 acres of land. Some of this is the most productive land found anywhere in the South. The Robinsonville, Commerce, Bosket and Dundee are all highly productive soils. Much of the county, however, is made up of the tough "buckshot" land which gives planters and operators some problems in land preparation and getting crops up to good stands. The soil types making up this land are Sharkey, Alligator and Dowling clays. See map in fig. 2 for location and extent of the Soil Associations in Washington County.

Washington County is one of the better agricultural counties in the Delta. It has large areas of productive land and a good shipping point in Greenville, on the Mississippi River. The county also has many large natural lakes which are old runs of the Mississippi River. These lakes, the Mississippi River, and the underground supply contain enough water to irrigate pratically all of the cultivated land within the county. This supply of water is a decided advantage in producing high crop yields which are essential in modern agriculture. The Delta Branch Experiment Station is located in the County. This Station provides research information helpful to all Delta planters and operators.

As a result of the cooperative effort of the Mississippi Experiment Station, the Soil Conservation Service and the taxpayers in Washington County, a soil survey of Washington County was initiated several years ago. During this survey, which was completed in 1957, every acre of land in the county was classified and mapped. Many farmers of Washington County already have soil maps of

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*The author gratefully acknowledges the help and assistance of personnel at the Delta Branch Experiment Station and the local Extension Service and Soil Conservation Service workers.

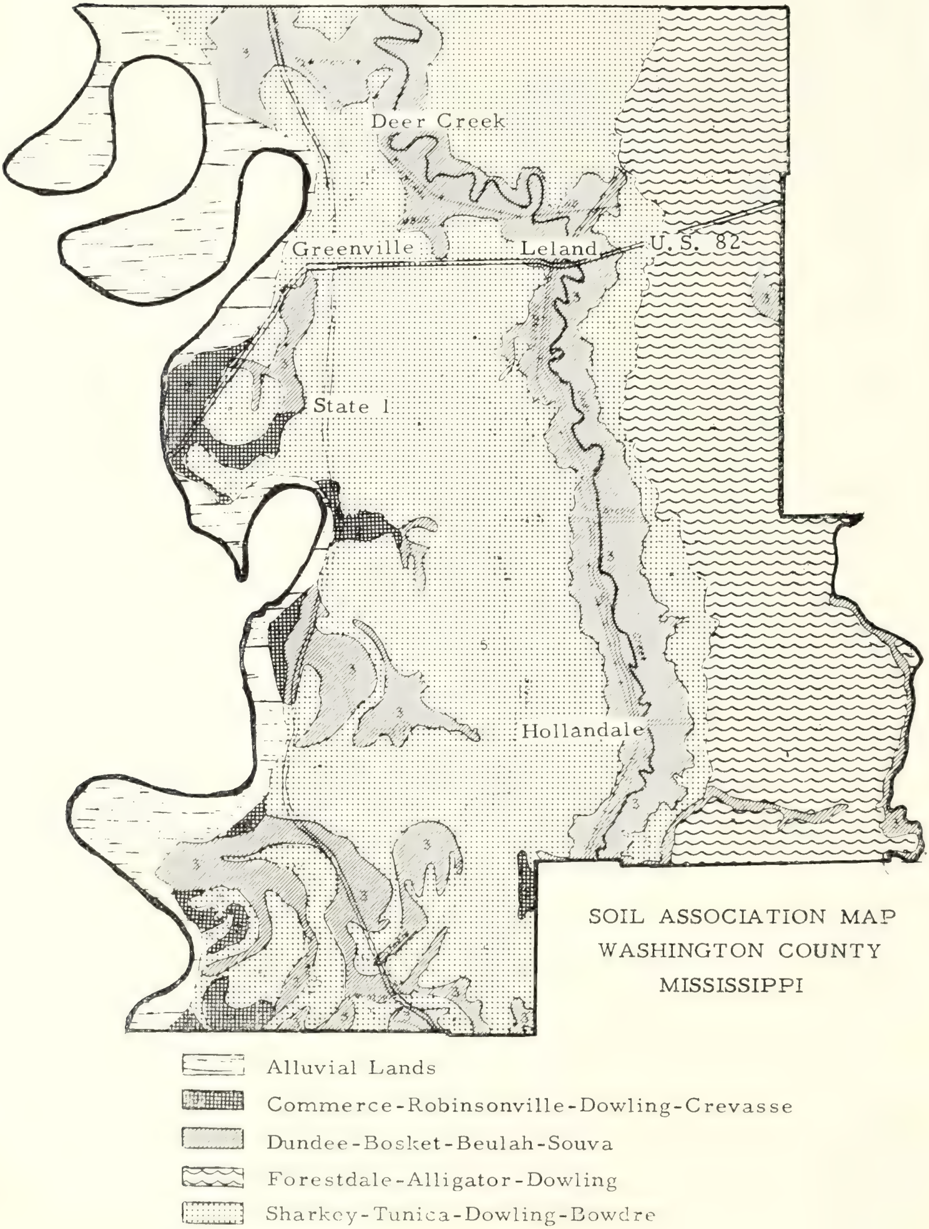

Deer Creek
Greenville
Leland
U.S. 82
State 1
Hollandale
SOIL ASSOCIATION MAP
WASHINGTON COUNTY
MISSISSIPPI
Alluvial Lands
Commerce-Robinsonville-Dowling-Crevasse
Dundee-Bosket-Beulah-Souva
Forestdale-Alligator-Dowling
Sharkey-Tunica-Dowling-Bowdre

Figure 2. Soil Association Map of Washington County

their farms. Those who do not can obtain maps through the Soil Survey Office or the County Agent's Office in Greenville. The soil map in general provides an inventory of the soil resources and serves as a land use guide for each planter or land owner. It is just as necessary for a planter to keep a soil inventory as it is for a business man to maintain a business inventory.

This publication provides information on the soils of the county and how the soil maps may be used to assist agricultural workers and farmers in improving the farm land and agricultural conditions in the county. It should be realized by all concerned that the great and lasting wealth of Washington County lies in the soils.

The soils of Washington County developed from alluvial materials which were deposited by the Mississippi River. During flood stages the Mississippi, like all streams, deposited materials of various textures and compositions. The sandy deposits are usually found in certain locations in alluvial flood plains. The meduim textured materials are found in others, and the fine or clayey deposits are found in still other locations. All of these were deposited by the same stream but under different conditions. The soils as now found in Washington County are closely associated with the types of soil materials which were originally deposited by the Mississippi River.

The fertility level was high when the materials were deposited. This property is still observed among the soils of the county. Most of the soils are deficient only in nitrogen. All of the other fertility elements are generally fairly high to high in the soils of the county. The soils respond well to good management and have high capacities for producing crop yields.

The topography or relief of Washington County is level to gently sloping. Some of the soils are found in depressional areas where surface water is a problem. The topography or lay of the land is quite favorable for the use of farm machinery. This is an important factor in the type of farming practiced in Washington County.

The soils of the county can be grouped into five groups or soil associations. This grouping is made on the basis of how the soils occur in the county. These groups are shown on the enclosed map. (figure 2).

The Value and Use of Soil Maps

Soil maps are made in order to benefit people who are interested in land in almost any way. They are sketches of land areas showing the soil types and other land features such as slopes and erosion conditions. These three factors generally give a good idea of the kind of land in a definite area and how it may be used.

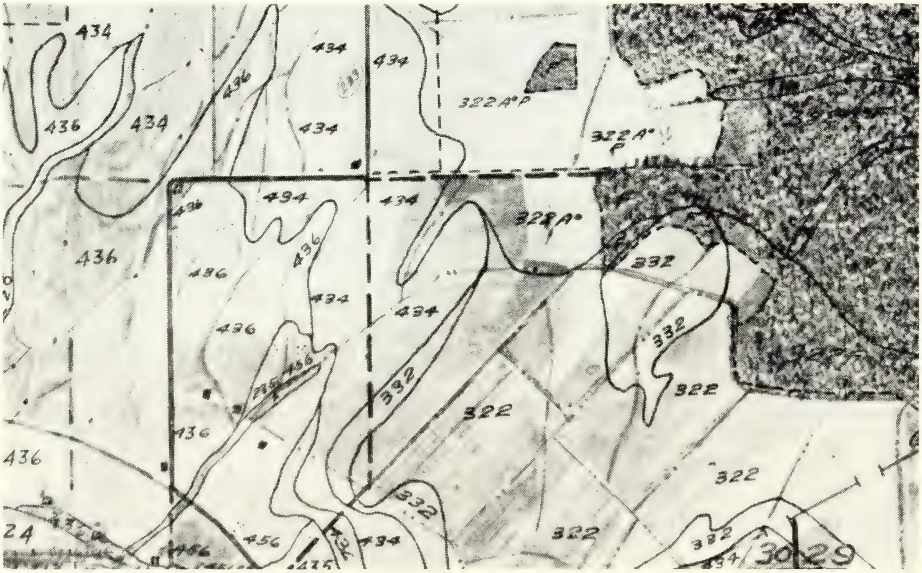
In the Delta area, slope and erosion are not as important and do not pose problems in land use as they do in the hill section. This means then that the soil types are far more important in general than the other features shown on the soil map. In other words, one of the main things to learn from a soil map is the kind of soil or soil type found in various fields.

In making the soil maps of the county, soil surveyors used aerial photographs as base maps. Soil maps will serve as a guide for farmers in using and managing every acre of land on farms. In some cases, a farm will be on a single photograph. In the case of some of the larger plantations, several photographs may be required to give complete coverage. The photograph also shows the type of cover on the land and other features such as roads, ditches, and buildings. These features are helpful to people using soil maps because they provide control which enables them to locate any part of the farm rather easily.

All maps have symbols which indicate various things. In this manner, a soil map is similar to a highway map or other types of maps. In the survey of the Delta area, symbols were set up to indicate the various types of soil. At the beginning, it was decided that three digit numbers would be used to indicate all soil types. The first symbol to be found in all areas on the map will be a three digit number such as 435, 136, or 322. These are the mapping symbols for the following soil types: Dundee silt loam, Commerce loam, and Sharkey clay.

After the soil type number, a capital letter will be found which indicates the slope or lay of the land. The A slope represents the level and the slope increases with each additional capital letter used. The third symbol will be a small number which indicates the erosion condition. As indicated earlier, erosion is not a serious problem on most Delta soils. Following the three conventional symbols (soil type, slope and erosion) a symbol may be found which indicates the present land use. The following land use conditions are recognized. L represents cultivated land; P pasture land; F forest or woodland; and X represents idle land. These various symbols put together on the map would be as follows: 446B2.—The 446 means the soil type is Dubbs loam; the B represents the slope which is gently sloping. The 2 represents the erosion which is moderate erosion. Along with these three symbols, there may be a symbol for the land use which would probably be L, (cultivated crops).

A capital letter sometimes precedes a soil number on the Washington County map. The letter D appears before some soil numbers along Deer



Key to numbering and lettering system used in surveying Washington County soils

436B2P

Position

1. First bottoms
2. Depressions (low swags)
3. Slackwater (low bottom)
4. Old natural levee formations

Internal Drainage

1. Poor
2. Poor to somewhat poor
3. Somewhat poor to moderately well
4. Moderately well to well
5. Well to somewhat excessive
6. Excessive

Surface Texture

1. Heavy clay (not used)
2. Clay
3. Silty clay
4. Silty clay loam
5. Silt loam
6. Very fine sandy loam
8. Loamy fine sand (not used)
9. Sand

Slope

A^o. 0 to 1/2% level
A . 1/2 to 2% (nearly level) (No letter follows the soil type)
B . 2 to 5% (gently sloping)
C . 5 to 8% (sloping)
D . 8% plus (escarpment)

Erosion

None to slight (less than 25% of the surface soil has been lost--no number follows the soil type symbol)
2. Moderate (25 to 75% of the surface soil has been lost)

Present Land Use

F. Forest
H. Home site
Cultivated crop land (no letter follows the soil type symbol)
P. Pasture (permanent)
X. Idle Land

Overflow phase

f Subject to annual overflow (should a lower case "f" follow the end of the symbol).

Depth phases

Shallow (soil symbols underscored once, indicates that the profile rest abruptly upon a clay layer at a depth of 12 to 20 inches).

Moderately shallow (soil symbol underscored twice, indicates that the profile rest abruptly upon a clay layer at a depth of 20 to 30 inches).

Overwash phases

+ Has had recent deposition over clay or silty clay soils.

Rice is a special crop. It grows well on the "Buckshot" Sharkey Clay soils. *(Courtesy of H. R. Caffey)*

Creek and T is used similarly in other rare instances. For management purposes these symbols may be disregarded.

Soil maps have many uses and purposes. For agricultural workers they are helpful in over-all community or county planning and in various production programs for various parts of the county. They also serve as a basis for making farm plans. Farmers can use them in planning cropping programs and in locating various fields, drainage ways, roads, and buildings. Soil maps are also very useful in the location of special crops such as orchards, rice, alfalfa, truck crops, and the like. Contractors and construction people can make use of soil maps in locating suitable sites for factories, buildings, highways and sewage disposal areas.

SOIL TYPES, ACRES AND USES IN WASHINGTON COUNTY

MAJOR SOIL TYPES:	ACRES and USES (1958)				
	Total	Cultivation	Pasture	Forest	Idle
Alligator Clay	36740	21540	1990	11880	1330
Alligator Silty Clay Loam	5150	4400	80	670	— —
Beulah Very Fine Sandy Loam	4280	3930	240	90	20
Bosket Silty Clay Loam	620	500	110	10	——
Bosket Very Fine Sandy Loam	25690	23710	1930	— —	50
Bowdre Silty Clay	3170	1290	1230	650	——
Bowdre Silty Clay Loam	940	700	220	20	— —
Commerce Silty Clay Loam	10140	9630	100	30	80
Commerce Silt Loam	1220	1170	50	——	——
Commerce Very Fine Sandy Loam	1820	1130	360	——	30
Commerce Silt Loam	480	440	40	— —	——
Crevassee Sandy Loams and Loamy Sands	950	400	550	——	——
Dowling Clay	51330	35070	6940	5904	3416
Dowling Soils	9000	7660	1050	290	— —
Dubbs Silt Loam	600	600	——	——	——
Dubbs Very Fine Sandy Loam	760	750	10	——	——
Dundee Silty Clay	2550	2060	450	10	30
Dundee Silty Clay Loam	17915	15015	2630	180	90
Dundee Silt Loam	3860	3680	220	——	— —
Dundee Very Fine Sandy Loam	22770	21080	1600	90	— —
Forestdale Silty Clay	16680	13800	1790	1020	70
Forestdale Silty Clay Loam	20750	17730	2540	470	10
Forestdale Silt Loam	6000	5890	110	——	——
Mhoon Silty Clay Loam	200	200	——	——	— —
Robinsonville Very Fine Sandy Loam	1430	1170	260	——	——
Sharkey Clay	139100	83190	12000	39910	4000
Sharkey Silty Clay Loam	4060	3720	20	320	——
Sharkey Very Fine Sandy Loam	2000	1660	60	260	20
Souva Silt Loam	940	940	——	——	— —
Tunica Clay	11640	5200	4700	1130	— —
Tunica Silty Clay Loam	455	455	——	——	— —

Classes of Land and General Treatment

Land is made up of soil conditions and can be classified many ways. The system of land capability classification as used in the Soil Conservation Service is an interpretative grouping of soils for agricultural purposes. Individual soil mapping units as shown on the soil maps are grouped into capability groupings so as to help landowners and others use and interpret the soil map. This grouping is based primarily on the capability of the soil to produce common cultivated crops and pasture plants without deterioration over a long period of time. The capability classification provides three main categories. The broadest is the land capability class, the second is the capability subclass, and the third is the land capability unit. These are designated by Roman numbers, letters (e, s, and w) and ordinary numbers. For example, IIs-2 is a capability unit.

Subclasses are groups of soils within classes that have the same kinds of dominant limitations for agriculture use. Some soils are droughty, others may be too wet, and others are subject to erosion. To show the kind of limitations found in the class, four subclasses are recognized. Subclasses are identified by a letter following the capability class number. The letter "e" indicates erosion is the main problem in the use of the soil. The letter "w" indicates excess water is the main problem. The letter "s" indicates that soil problems such as low moisture holding capacity or fine textures are the main problems. The letter "c" indicates climatic conditions are the principal hazards. The subclass "c" is not recognized in Washington County. The land classes and subclasses are as follows:

Classes of Land in Washington County

Mapping Number and Soil Name.

Class I. Extra good land well suited for row crops and all other uses except rice production.

135, Commerce silt loam, nearly level phase.
136, Commerce very fine sandy loam, nearly level phase.
445, Dubbs silt loam, nearly level phase.
446, Dubbs very fine sandy loam, nearly level phase.
435, Dundee silt loam, nearly level phase.
436, Dundee very fine sandy loam, nearly level moderately shallow phase.
T835, Pearson silt loam, nearly level phase.
456, Bosket very fine sandy loam, nearly level moderately shallow phase.
466, 467, Beulah very fine sandy loam, nearly level moderately shallow phase.
156, 157, Robinsonville very fine sandy loam.
436, Dundee very fine sandy loam, nearly level shallow phase.

Class II. Good land with some problems and limitations.

Subclass IIe—Good land but erosion should be controlled.

435B, 435C, Dundee silt loam, gently sloping phase.
436B, Dundee very fine sandy loam, gently sloping phase.

456B, 456C, Bosket very fine sandy loam, gently sloping phase.
434B, Dundee silty clay loam, gently sloping phase.

Subclass IIs—Good land but the soils have some property, as texture, that requires special treatment for production of high crop yields.

466, 467, Beulah very fine sandy loam, nearly level phase.
466B, 467B, Beulah very fine sandy loam, gently sloping phase.
343, 463, 133, 123, Bowdre silty clay, nearly level phase.
433, Dundee silty clay, nearly level phase.
332, Tunica clay, nearly level phase.
426, 425, T825, Forestdale silt loam, nearly level phase.
225, 326, Sharkey very fine sandy loam, nearly level overwash phase.
454, Bosket silty clay loam, nearly level phase.
344, 464, Bowdre silty clay loam, nearly level phase.
434, Dundee silty clay loam, nearly level phase.
334, Tunica silty clay loam, nearly level phase.

Subclass IIw—Good land but surface water is a problem in farm operations.

235, 234, 236, Souva silt loam.

Class III. Fairly good land with some properties or limitations which require special management practices in order to produce cultivated crops. The number of crops is also limited.

Subclass IIIe—Soils with fairly heavy textures and erosion is a problem.

433C, Dundee silty clay loam, sloping phase.
424B, 424C, Forestdale silty clay loam, gently sloping phase.

Subclass IIIs—Soils with heavy textures which present problems.

433B, 433 C, Dundee silty clay, gently sloping phase.
332B, 332C, Tunica clay, gently sloping phase.
312, Alligator clay, nearly level phase.
312 B, Alligator clay, gently sloping phase.
423, Forestdale silty clay, nearly level phase.
423B, Forestdale silty clay, gently sloping phase.
322, Sharkey clay, nearly level phase.
322B, Sharkey clay, gently sloping phase.

Subclass IIIw—Poorly drained soils and surface water is the problem.

314A°, Alligator silty clay loam, level phase.
312A°, Alligator clay, level phase.
322A°, Sharkey clay, level phase.
220, Dowling soils.

"Skip row" planting is a practice used to increase yields of cotton on good cotton land (Dundee loam). *(Courtesy of Mississippi Extension service)*

Soybeans grow well on Sharkey clay or "Buckshot" soils. *(Courtesy of Delta Branch Experiment Station)*

Class IV. Land with severe limitations and suited only to an occasional row or cultivated crop.

Subclass IVw—Depressional land where water is a problem.

212, Dowling clay.

Subclass IVs—Sandy land which holds little moisture and crops suffer during dry periods.

176, 178, Crevasse sandy loam and loamy sands.

NOTE: On the soil map: Single underscore means shallow phase of soil.
Double underscore means moderately shallow phase of soil.

CAPABILITY UNITS IN WASHINGTON COUNTY

CAPABILITY UNIT (I-1)
- Commerce silt loam, nearly level phase.
- Commerce very fine sandy loam, nearly level phase.
- Commerce very fine sandy loam, nearly level moderately shallow phase.
- Dubbs silt loam, nearly level phase.
- Dubbs very fine sandy loam, nearly level phase.
- Dundee silt loam, nearly level phase.
- Dundee very fine sandy loam, nearly level moderately shallow phase.
- Pearson silt loam, nearly level phase.

CAPABILITY UNIT (I-2)
- Bosket very fine sandy loam, nearly level moderately shallow phase.
- Bosket very fine sandy loam, nearly level phase.
- Beulah very fine sandy loam, nearly level moderately shallow phase.
- Robinsonville very fine sandy loam.

CAPABILITY UNIT (I-3)
- Dundee very fine sandy loam, nearly level shallow phase.
- Commerce silt loam, nearly level shallow phase.

CAPABILITY UNIT (IIe-1)
- Dundee silt loam, gently sloping phase.
- Dundee very fine sandy loam, gently sloping phase.

CAPABILITY UNIT (IIe-2)
- Bosket very fine sandy loam, gently sloping phase.

CAPABILITY UNIT (IIe-4)
- Dundee silty clay loam, gently sloping phase.

CAPABILITY UNIT (IIs-1)
- Beulah very fine sandy loam, nearly level phase.
- Beulah very fine sandy loam, gently sloping phase.

CAPABILITY UNIT (IIs-2)
- Bowdre silty clay, nearly level phase.
- Dundee silty clay, nearly level phase.
- Tunica clay, nearly level phase.

CAPABILITY UNIT (IIs-3)
- Forestdale silt loam, nearly level phase.

CAPABILITY UNIT (IIs-5)
- Sharkey very fine sandy loam, nearly level overwash phase.

CAPABILITY UNIT (IIs-6)
- Bosket silty clay loam, nearly level phase.
- Bowdre silty clay loam, nearly level phase.
- Commerce silty clay loam, nearly level phase.
- Dundee silty clay loam, nearly level phase.

Tunica silty clay loam, nearly level phase.

CAPABILITY UNIT (IIw-3)

Souva silt loam.

CAPABILITY UNIT (IIIe-3)

Dundee silty clay loam, sloping phase.

CAPABILITY UNIT (IIIe-5)

Forestdale silty clay loam, gently sloping phase.

CAPABILITY UNIT (IIIs-2)

Dundee silty clay, gently sloping phase.

Tunica clay, gently sloping phase.

CAPABILITY UNIT (IIIs-4)

Alligator clay, nearly level phase.

Alligator clay, gently sloping phase.

Forestdale silty clay, nearly level phase.

Forestdale silty clay, gently sloping phase.

Sharkey clay, nearly level phase.

Sharkey clay, gently sloping phase.

CAPABILITY UNIT (IIIw-5)

Alligator silty clay loam, level phase.

CAPABILITY UNIT (IIIw-11)

Alligator clay, level phase.

Sharkey clay, level phase.

CAPABILITY UNIT (IIIw-13)

Dowling soils.

CAPABILITY UNIT (IVw-1)

Dowling clay.

CAPABILITY UNIT (IVs-1)

Crevasse sandy loam and loamy sands.

Cotton is "King" of crops in Washington County and can be harvested with machinery. (*Courtesy of Mississippi Agricultural Extension Service*)

TABLE 1.

Estimated average acre yields of principal crops on the soils of Washington County, Miss. under two levels of management; yields in columns B are those obtained under common management; those in columns A under good management.

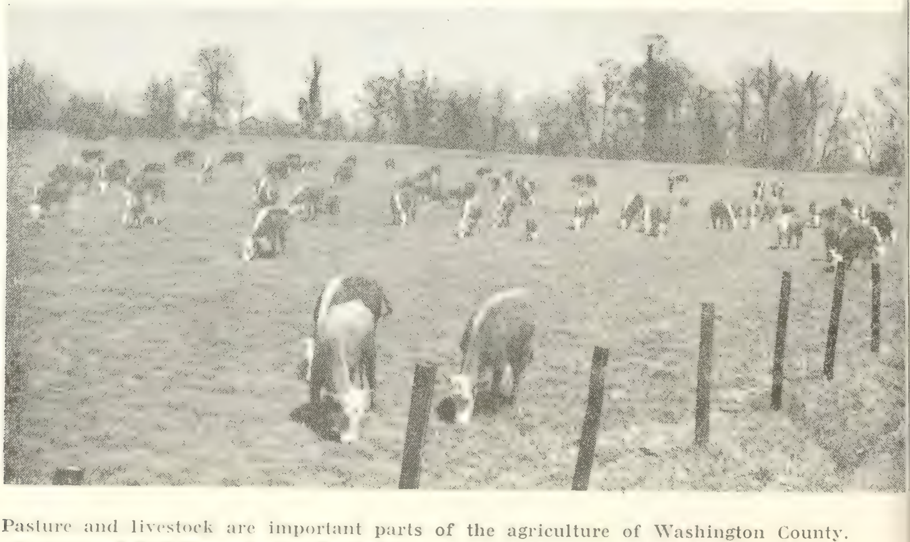
Blank spaces in columns indicate crop is not commonly recommended under the management specified.

Alluvial lands (unclassified)	Cotton		Corn		Soybeans		Oats		Rice		(1) Permanent Pasture	
	A	B	A	B	A	B	A	B	A	B	A	B
	Lbs. of Lint		Bu.		Bu.		Bu.		Bu.		Acres per animal unit	
ALLIGATOR CLAY:												
Level phase	275	175	—	—	25	10	—	—	85	55	3.0	6.0
Nearly level phase	400	225	—	—	35	20	50	30	85	55	3.0	6.0
Gently sloping phase	400	225	—	—	35	20	50	30	—	—	2.5	5.5
Silty clay loam, level phase	300	175	—	—	25	10	—	—	85	55	3.0	6.0
Nearly level phase	125	225	—	—	35	25	50	30	85	55	2.5	5.5
BEULAH												
Very fine sandy loam, nearly level phase	150	375	15	25	—	—	55	30	—	—	2.0	4.0
Very fine sandy loam, gently sloping phase	425	350	35	20	—	—	55	30	—	—	2.0	4.0
Very fine sandy loam nearly level, moderately shallow phase	550	450	65	40	—	—	65	35	—	—	2.0	4.0
BOSKET:												
Silty clay loam, nearly level phase	600	175	65	35	35	20	65	30	—		2.0	4.0
Very fine sandy loam, nearly level phase	800	675	80	45	35	20	65	30	-		2.0	4.5
Very fine sandy loam, gently sloping phase	50	525	65	35	30	20	65	30	—	—	2.0	4.0
Very fine sandy loam, nearly level moderately shallow phase	50	625	80	45	35	20	65	35	—	—	2.0	4.5
BOWDRE:												
Silty clay, nearly level phase	450	325	45	30	25	15	50	30	—	—	2.5	4.5
Silty clay loam, nearly level phase	450	325	65	30	25	15	50	30	—	—	2.5	4.5
COMMERCE:												
Silty clay loam, nearly level phase	725	650	60	35	40	30	55	35	—	—	2.5	4.5
Silt loam, nearly level phase	800	675	90	45	45	30	65	10	—	—	2.2	4.2
Very fine sandy loam, nearly level phase	800	765	90	45	45	30	65	40		-	2.2	4.2
Very fine sandy loam, nearly level, moderately shallow phase	750	625	85	10	45	30	65	40	—	—	2.2	4.2
Silt loam, nearly level shallow phase	750	625	85	40	45	30	65	10		-	2.2	4.2
CREVASSE:												
Sandy loams and loamy sands	—	—	—	—	—	—	—	—	—	-	—	—
Dowling clay	—	—	—	-	30	15	-	—	85	55	—	—
Dowling soils	300	200	35	15	30	15	—	—	85	55	—	-

(1) Average number of acres required to furnish without injury to the pasture, adequate grazing for 1 animal unit for a grazing season of 215 days. An animal unit is equivalent to 1 mature cow, steer, or horse, 5 hogs, or sheep, or goats.

Alluvial lands (unclassified)	Cotton		Corn		Soybeans		Oats		Rice		Permanent Pasture	
	A	B	A	B	A	B	A	B	A	B	A	B
	Lbs. of Lint		Bu.		Bu.		Bu.		Bu.		Acres per animal unit	
DUBBS:												
Silt loam, nearly level phase	800	675	90	45	35	25	65	40	—	—	2.2	4.2
Very fine sandy loam, nearly level phase	800	675	90	45	35	25	65	40	—	—	2.2	4.2
DUNDEE:												
Silty clay, nearly level phase	600	450	45	30	35	20	55	35	80	55	2.5	4.5
Silty clay, gently sloping phase	550	400	40	30	30	15	55	30	—	—	2.5	4.5
Silty clay loam, nearly level phase	650	525	55	30	35	20	55	35	80	55	2.0	4.0
Silty clay loam, gently sloping phase	550	400	55	30	30	15	55	35	—	—	2.0	4.0
Silty clay loam, sloping phase	450	375	50	25	25	15	50	30	—	—	2.0	4.0
Silty clay loam, nearly level, shallow phase	700	550	70	35	35	20	55	35	70	10	2.5	4.5
Silt loam, nearly level phase	750	625	90	45	35	20	60	40	—	–	2.2	4.2
Silt loam, gently sloping phase	650	400	75	30	30	15	60	40	—	—	2.2	4.2
Very fine sandy loam nearly level shallow phase	725	600	85	40	35	20	60	40	—	—	2.2	4.2
Very fine sandy loam nearly level moderately shallow phase	725	600	85	10	35	20	60	40	—	—	2.2	4.2
Very fine sandy loam, nearly level phase	750	625	90	15	35	20	65	45	—	—	2.2	4.2
Very fine sandy loam, gently sloping phase	650	400	75	30	30	15	60	40	—	—	2.4	4.2
FORESTDALE:												
Silty clay, nearly level phase	452	225	—	—	35	20	50	30	85	55	3.0	6.0
Silty clay, gently sloping phase	375	225	—	—	30	15	50	30	—	—	2.5	5.5
Silty clay loam, nearly level phase	500	350	—	—	35	20	50	30	85	55	2.5	4.5
Silty clay loam, gently sloping phase	75	325	—	—	30	15	50	30	—	—	2.5	4.5
Silt loam, nearly level phase	50	375	55	35	35	20	50	30	70	50	2.5	4.5
MHOON:												
Silty clay loam	450	350	—	—	40	25	50	30	85	55	2.5	4.5
PEARSON:												
Silty loam, nearly level phase	750	625	90	45	35	20	60	40	—	—	2.5	4.5
ROBINSONVILLE:												
Very fine sandy loam	825	700	90	45	—	–	65	45	—	—	1.5	3.0
SHARKEY CLAY:												
Level phase	250	175	—	—	30	10	45	25	85	55	5.0	—
Nearly level phase	400	300	45	25	40	20	45	25	85	55	3.0	5.0
Gently sloping phase	400	300	40	20	40	25	45	25	—	—	3.0	5.0
SHARKEY:												
Silty clay loam, nearly level phase	400	300	50	30	10	25	50	30	85	55	3.0	5.0
Very fine sandy loam, nearly level overwash phase	500	375	55	40	40	25	50	30	85	55	3.0	5.0
SOUVA:												
Silt loam	500	350	85	45	35	26	—	—	—	—	2.2	4.2
TUNICA:												
Clay, nearly level phase	600	450	50	25	40	25	55	35	70	50	3.0	5.0
Silty, Clay loam, nearly level phase	650	475	60	30	25	15	55	35	—	—	3.0	5.0

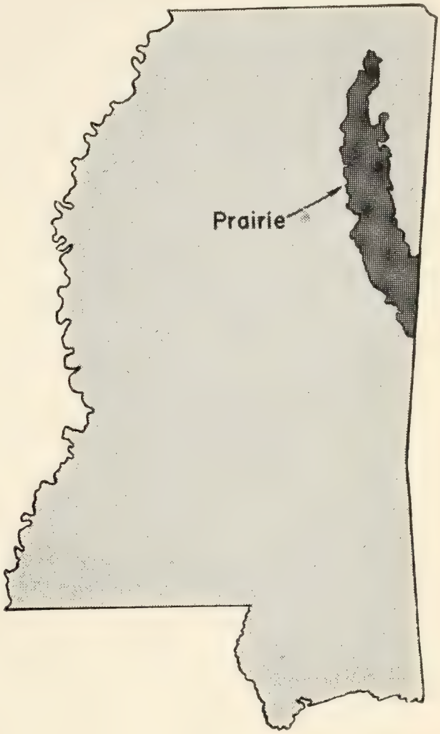
Class 1 land (Dubbs silt loam) is used for the production of cotton.
(*Courtesy of Delta Branch Experiment Station*)



Pasture and livestock are important parts of the agriculture of Washington County.
(*Courtesy of Soil Conservation Service*)

BULLETIN 585 NOVEMBER 1959

Farm Pastures of the Prairie Area of Mississippi



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AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

Summary and Conclusions

This study was conducted for the purpose of providing monthly estimates of livestock-carrying capacities of pastures in the Prairie Area of Mississippi, together with the associated costs, by type of land and type of sod.

These estimates were obtained for two types of land (1) land ranging from well-drained to low and wet, and (2) land which is drier than that included in the first type. Three types of sod were considered: (a) Bermuda and Dallis sods, (b) Bermuda and Dallis sods with small grains sod-seeded, and (c) fescue sods.

Estimates were also obtained for two levels of improvement for each land-type, sod-type combination. In addition, estimates were obtained for two levels of improvement for (a) small grains on cropland and (b) Sudan or millet.

For each type of sod or grazing crop studied, more grazing was obtained from Type 1 land than from Type 2 land. Likewise more grazing was obtained from the higher level of improvement than from the lower level.

Profitability of pasture improvement depends upon the manner in which the added grazing is utilized. However, another research project indicates that pasture improvement, at least to the average level reported in this study, is extremely profitable when the pasture is fully utilized. These results will be published in a Mississippi Agricultural Experiment Station bulletin entitled "An Economic Evaluation of Alternative Methods of Beef Production in the Prairie Area of Mississippi."

FARM PASTURES OF THE PRAIRIE AREA OF MISSISSIPPI

By T. E. TRAMEL, D. W. PARVIN,
and J. E. BETTS

The Problem. The soils of the Prairie area of Mississippi are well suited to grassland farming. A growing shortage of farm labor, relatively high prices for livestock and livestock products, and governmental cotton acreage reduction programs have given added interest to using livestock as one of the main enterprises on prairie farms.

For more than the past decade considerable emphasis has been given to pasture improvement as a means of increasing both the quantity and quality of available grazing. It was the purpose of this study to determine the effect of pasture improvement that farmers are actually doing upon carrying capacities, and at the same time provide monthly estimates of carrying capacities for different sods and different types of land for varying levels of improvement.

Method of Study. Data for the study were obtained by personal interviews with 269 livestock producers in the Prairie area of the state. Details of procedures used in calculating pasture costs and carrying capacities are given in the Appendix.

Land Use

Size of farms studied averaged 532 acres, of which 87 percent was owned by the operator (Table 1). Open permanent pastures accounted for slightly more than half of the land. Cropland accounted for approximately another third. Open permanent pasture was almost equally divided between native pastures and land which had been seeded with at least one kind of pasture plant.

DEFINITIONS

Throughout this report, including tables and the Appendix, the following terms apply:

Land Types

Type 1 land is well drained to low and wet.

Type 2 land is drier than Type 1.

Levels of Improvement

No improvement refers to all observations with no annual costs for land preparation, fertilization, or seeding.

Some improvement refers to all observations with an annual cost for at least one of these items.

Lower half and upper half refer a division of all observations on the basis of annual costs other than mowing.

Annual Costs and Carrying Capacities

Bermuda and Dallis Sods. Slightly more than half of the individual pasture areas studied which were classified as Bermuda and Dallis sods had no pasture improvement practices other than mowing (Table 2) Cow-days of grazing per acre for this type of pasture averaged 77 as contrasted to 102 for the areas which had some improvement. Annual pasture costs for the two groups averaged $0.81 and $3.44, respectively.

Land classed as Type 1 land appears to be better pasture land than that classed as Type 2. Cow-days of grazing averaged 99 for Type 1 compared to 80 for Type 2, with little difference shown in annual cost. The same relationship is shown between land types for the no improvement situation and for the some improvement situation.

Bermuda and Dallis Sods with Small Grains Sod-Seeded. Greater differences in grazing were shown between land-types than between the lower and upper half for this type of sod (Table 3). Cow-days of grazing per acre averaged 177 for Type 1 land compared to 146 for Type 2 land. Annual costs averaged $17.74 and $15.51, respectively. As was the case with Bermuda and Dallis sods, the same relationship is shown for both levels of improvement. Of the average of 162 cow-days of grazing per acre for this sod-type, 48 were during the period April 1 to October 31.

Fescue Sods. Considerable differences in grazing were shown between land types and between levels of improvement for fescue sods (Table 4). Farmers having an annual cost of $2.26 per acre obtained 132 cow-days of grazing per acre compared to 182 days for farmers having an annual cost of $10.38. Type 1 land furnished 162 cow-days of grazing compared to 148 days for Type 2 land, both types having essentially the same average cost.

Table 1. Average land use for 269 Prairie farms, Mississippi, 1956.

Item	Acres	Percent of total
Owned	462	87
Rented-in	85	13
Rented-out	15	-----
Operated	532	100
Cropland	164	31
Seeded permanent pasture	149	28
Native permanent pasture	133	25
Woodland pasture	50	9
Woodland	17	3
Other land	19	4
Total	532	100

Table 2. Annual costs per acre, Bermuda and Dallis sods, by type of land and level of improvement, 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Annual costs (dollars)					No. cow-days grazing[1]
		Mowing	Land prep.	Fertilizer	Seed	Total	
Type 1 land, no improvement	207	.84	----	------	----	.84	89
Type 2 land, no improvement	224	.78	----	------	----	.78	66
Type 1 land, some improvement	186	1.16	.42	1.49	.54	3.61	110
Type 2 land, some improvement	202	1.10	.40	1.20	.58	3.28	95
Type 1 land, all farms	393	.99	.20	.71	.25	2.15	99
Type 2 land, all farms	426	.93	.19	.57	.28	1.97	80
No improvement, all farms	431	.81	.00	.00	.00	.81	77
Some improvement, all farms	388	1.13	.41	1.33	.57	3.44	102
All farms	819	.96	.20	.64	.27	2.07	90

[1] For seasonal distribution of grazing see Appendix Table 1.

Small Grains and Sudan or Millet.

Cow-days of grazing by level of annual cost for small grains on cropland and for Sudan or millet are presented in Table 5. For small grains, cow-days of grazing averaged 116 per acre per year at a cost of $20.60. For Sudan or millet an average of 128 days was obtained at a cost of $14.38..

Table 3. Annual costs per acre, Bermuda and Dallis sods with small grains sod-seeded, by type of land and level of improvement 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Annual costs (dollars)					No. cow-days grazing[1]
		Mowing	Land prep.	Fertilizer	Seed	Total	
Type 1 land, lower half	31	1.46	3.03	3.70	4.36	12.55	177
Type 2 land, lower half	31	.85	3.31	2.56	4.03	10.75	142
Type 1 land, upper half	31	1.25	4.94	11.17	5.56	22.92	178
Type 2 land, upper half	32	.71	4.70	9.36	5.36	20.13	152
Type 1 land, all farms	62	1.36	3.99	7.43	4.96	17.74	177
Type 2 land, all farms	63	.78	4.01	6.01	4.71	15.51	146
Lower half, all farms	62	1.16	3.17	3.13	4.19	11.65	160
Upper half, all farms	63	.98	4.82	10.27	5.46	21.53	165
All farms	125	1.07	4.00	6.72	4.83	16.62	162

[1] For seasonal distribution of grazing see Appendix Table 2.

Table 4. Annual costs per acre, fescue sods, by type of land and level of improvement, 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Annual costs (dollars)					No. cow-days grazing[1]
		Mowing	Land prep.	Fertilizer	Seed	Total	
Type 1 land, lower half	42	.87	.42	.39	.56	2.24	135
Type 2 land, lower half	21	.75	.41	.33	.80	2.29	127
Type 1 land, upper half	43	.85	1.67	6.59	.91	10.02	189
Type 2 land, upper half	21	.94	1.81	7.72	.64	11.11	170
Type 1 land, all farms	85	.86	1.05	3.53	.74	6.18	162
Type 2 land, all farms	42	.85	1.11	4.02	.72	6.70	148
Lower half, all farms	63	.83	.42	.37	.64	2.26	132
Upper half, all farms	64	.88	1.72	6.96	.82	10.38	182
All farms	127	.86	1.07	3.69	.74	6.36	158

[1] For seasonal distribution of grazing see Appendix Table 3.

Table 5. Annual costs per acre, small grains on cropland and Sudan and millet, by level of improvement, 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Annual costs (dollars)				No. cow-days grazing[1]
		Land prep.	Fertilizer	Seed	Total	
Small grains on cropland:						
Lower half	28	4.92	6.23	4.72	15.87	110
Upper half	29	6.78	12.26	6.11	25.15	121
All farms	57	5.88	9.29	5.43	20.60	116
Sudan and millet:						
Lower half	13	3.68	3.67	2.94	10.29	118
Upper half	14	4.85	9.00	4.34	18.19	137
All farms	27	4.28	6.44	3.66	14.38	128

[1] For seasonal distribution of grazing see Appendix Table 4.

APPENDIX

Methods Used in Calculating Annual Pasture Costs and Carrying Capacities

Data were collected separately for five types of land and forty different combinations of permanent pasture plants. In the analysis, however, it was necessary, because of limited numbers of observations, to combine land types until only two remained and to combine sod types until only three remained.

The two land types used were: (1) land ranging from well-drained to low and wet, and (2) land drier than the first type. The three sod types used were: (a) Bermuda and Dallis grass sods, (b) Bermuda and Dallis grass sods with small grains sodseeded, and (c) fescue sods.

The number of cases reported refers to the number of observations prior to combining several groups, i.e., for one farm there might have been several observations which were later combined into one. In addition to permanent pasture, data were collected for small grains on cropland and sudan and millet.

Costs. Farmer estimates of quantities of seeds and fertilizers applied during 1950-1956 and land preparation and mowing done during the same period were used in calculating annual pasture costs. In calculating costs for each item, average prices paid by farmers during 1952-56 for seed and fertilizers were used (Appendix Tables 6 and 7). Costs for land preparation and mowing

Appendix Table 1. Bermuda and dallis grass sods—normal carrying capacities per acre, by type of land and level of improvement, 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Number of mature cows							
		Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.
Type 1 land, no improvement	207	.16	.37	.53	.53	.44	.36	.30	.21
Type 2 land, no improvement	224	.14	.31	.42	.39	.31	.25	.20	.14
Type 1 land, some improvement	186	.27	.53	.68	.63	.52	.40	.33	.24
Type 2 land, some improvement	202	.21	.44	.60	.57	.45	.36	.29	.20
Type 1 land, all farms	393	.21	.44	.60	.58	.48	.38	.32	.22
Type 2 land, all farms	426	.17	.37	.50	.48	.38	.30	.25	.17
No improvement, all farms	431	.15	.34	.47	.46	.37	.31	.25	.18
Some improvement, all farms	388	.24	.49	.63	.60	.48	.38	.31	.22
All farms	819	.19	.41	.55	.53	.43	.34	.28	.20

Appendix Table 2. Bermuda and dallis grass sods with small grains sod-seeded—normal carrying carrying capacities per acre, by type of land and level of improvement, 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Number of mature cows											
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Type 1 land, lower half	31	.24	.35	.63	.96	.95	.67	.59	.48	.41	.30	.11	.11
Type 2 land, lower half	31	.25	.32	.51	.68	.73	.58	.45	.40	.33	.21	.06	.13
Type 1 land, upper half	31	.37	.47	.63	.79	.93	.71	.58	.45	.31	.22	.16	.23
Type 2 land, upper half	32	.28	.43	.63	.83	.83	.58	.42	.35	.21	.15	.11	.18
Type 1 land, all farms	62	.31	.41	.63	.88	.94	.69	.58	.47	.36	.26	.13	.17
Type 2 land, all farms	63	.27	.37	.57	.75	.78	.58	.43	.37	.27	.18	.09	.15
Lower half, all farms	62	.24	.34	.57	82	.84	.62	.52	.44	.37	.26	.08	.12
Upper half, all farms	63	.32	.45	.63	.81	.88	.65	.50	.40	.26	.18	.14	.20
All farms	125	.29	.39	.60	.82	.86	.63	.51	.42	.31	.22	.11	.16

(Appendix Table 8) were based on farm management studies and adjusted to the 1952-56 period.

After calculating cost of each item used in pasture improvement, cost of each item was prorated to an annual basis by the following methods: For annual plants, seeds and their application were charged to the year applied. For perennials, costs of seeds, their application, and land preparation were distributed over a ten-year period. For fertilizers and for applying fertilizers, nitrogen was charged to the year applied; 40 percent of the cost of phosphates, potash, and basic slag was charged to the year applied, 40 percent to the second year, and the remaining 20 percent to the third year. Twenty percent of the cost of lime and its application was charged to each of the first four years, 10 percent to the fifth and 10 percent to the sixth. Costs presented are for the year 1956 calculated on this basis.

Carrying Capacities. For each of the original types of land and for each of the original sod types, farmers estimated the number of mature cows which could secure adequate grazing in each month of a normal year from the acreage he had, with pasture growth not accumulating from month to month. These estimates were then divided by the acreages for

Appendix Table 3. Fescue sods—normal carrying capacities per acre, by type of land and level of improvement, 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Number of mature cows											
		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Type 1 land, lower half	42	.23	.27	.39	.55	.65	.58	.45	.35	.30	.26	.20	.20
Type 2 land, lower half	21	.16	.22	.41	.56	.59	.51	.40	.35	.33	.29	.19	.17
Type 1 land, upper half	43	.44	.47	.62	.83	.84	.67	.46	.38	.36	.36	.37	.41
Type 2 land, upper half	21	.43	.49	.66	.80	.77	.58	.38	.33	.30	.27	.23	.35
Type 1 land, all farms	85	.34	.37	.51	.69	.74	.63	.45	.37	.33	.31	.29	.31
Type 2 land, all farms	42	.29	.35	.53	.68	.68	.55	.39	.34	.32	.28	.21	.26
Lower half, all farms	63	.21	.25	.40	.55	.63	.56	.43	.35	.31	.27	.20	.19
Upper half all farms	64	.44	.48	.63	.82	.82	.64	.42	.36	.34	.33	.32	.39
All farms	127	.32	.37	.52	.69	.73	.60	.44	.35	.33	.30	.26	.29

Appendix Table 4. Small grains on cropland—normal carrying capacities per acre, by level of improvement, 269 Prairie farms, Mississippi, 1956.

Item	No. cases	Number of mature cows							
		Jan.	Feb.	Mar.	Apr.	May	June	Nov.	Dec.
Lower half	28	.39	.48	.70	.91	.78	.17	.04	.16
Upper half	29	.44	.56	.77	.96	.73	.16	.12	.27
All farms	57	.42	.52	.74	.94	.75	.17	.08	.22

Appendix Table 5. Sudan and millet—normal carrying capacities per acre, by level of improvement, 269 Prairie farms, Mississippi, 1956.[1]

Item	No. cases	Number of mature cows				
		June	July	Aug.	Sept.	Oct.
Lower half	13	.16	.93	1.61	1.12	.36
Upper half	14	.07	1.12	1.65	.79	.21
All farms	27	.16	.93	1.61	1.12	.36

[1] Seasonal distribution can be varied by varying planting dates.

each land-type, sod-type combination to obtain estimates for carrying capacities for each land-type, sod-type combination on each farm. The latter figures were then grouped for the different situations presented.

Appendix Table 6. Fertilizer costs per ton used in calculating pasture costs, 269 Prairie farms, Mississippi, 1956.

Kind of fertilizer	Cost per ton	Kind of fertilizer	Cost per ton
	Dollars		Dollars
0 - 14 - 14	42.50	Nitrate of soda	66.10
4 - 8 - 4	39.10	Calcium phosphate	18.90
4 - 12 - 12	45.80	Superphosphate (18%)	25.30
5 - 10 - 5	43.80	Superphosphate (20%)	28.40
6 - 6 - 4	41.00	Triple superphosphate (40%)	50.70
6 - 8 - 4	43.80	Triple superphosphate (42%)	53.20
6 - 8 - 8	46.60	Triple superphosphate (45%)	57.00
12 - 12 - 12	64.70	Triple superphosphate (48%)	60.80
13 - 13 - 13	70.10	Rock phosphate	17.80
14 - 14 - 14	75.50	Muriate of potash	44.60
Anhydrous ammonia	129.10	Lime	3.75
Ammonium nitrate	78.60	Basic slag	15.00
Calcium nitrate	62.00		

Appendix Table 7. Seed costs per pound used in calculating pasture costs, 269 Prairie farms, Mississippi, 1956.

Kind of seed	Cost per ton	Kind of seed	Cost per ton
	Dollars		Dollars
Black medic clover	.20	Ladino clover	.92
Bur clover	.24	Vetch (hairy)	.18
Button clover	.24	Wild winter peas	.10
Crimson clover	.30	Bahia grass	.35
Hop clover	.40	Bermuda grass	.71
Lappacea clover	.30	Carpet grass	.20
Lespedeza, common	.57	Dallis grass	1.00
Lespedeza, Kobe	.26	Fescue	.25
Lespedeza, Korean	.20	Johnson grass	.25
Melilotus clover	.20	Millet	.14
Persian clover	.35	Oats	.05
Red clover	.47	Ryegrass	.12
Sericea	.33	Sudan	.13
White clover	.87	Wheat	.06

Appendix Table 8. Costs per acre once over equivalent for land preparation, applying fertilizers, seeding and mowing used in calculating pasture costs, 269 Prairie farms, Mississippi, 1956.

Operation	Tractor	Equipment	Labor	Total
	—Dollars—			
Breaking (2-bottom plow)	1.10	.35	.60	2.05
Discing (tandem or double action disc)	.45	.20	.25	.90
Discing (single action disc-single cut)	.30	.15	.20	.65
Seeding (hand cyclone seeder)			.15	.15
Seeding (drill)	.35	.30	.25	.90
Sod seeding (pasture dream)	.60	1.85	.35	2.80
Renovating	1.45	.50	.80	2.75
Fertilizing (ezee flow)	.50	.25	.30	1.05
Cultipacking	.30	.10	.15	.55
Spreading manure (manure spreader)	1.30	.60	.85	2.75
Mowing	.35	.40	.20	.95
Harrowing	.25	.05	.15	.45

BULLETIN 586 NOVEMBER 1959

Peach Varieties For Mississippi

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Mississippi State University
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

On the cover: A three-year-old Redhaven peach tree which has been pruned moderately.

PEACH VARIETIES FOR MISSISSIPPI

By J. P. OVERCASH

The peach variety testing program of the Mississippi Agricultural Experiment Station has been in progress for many years. The primary emphasis is on fruit characteristics. Some of the fruit records reported here were from trees planted in 1938. New varieties are added to the orchards at State College annually and older varieties are discarded. Some years as many as 150 varieties and selections from breeders have been grown.

Peach varieties are propagated by budding and the only differences in the performance between trees of the same varieties are due to seedling root-stock influence or to climatic and soil or cultural influences.

New varieties are named in great numbers by both public and private breeders from controlled crosses and progeny of known parentage. A number of worthwhile varieties, such as Elberta, have come from chance seedlings. A third source of peach varieties is the occasional "bud sport" or mutation which has a worthwhile characteristic such as earliness or greater skin coloration than the parent tree on which it arose. Goldray is an early ripening bud sport of Golden Jubilee. The fruits of these varieties are very similar in appearance, shape, color, texture, flavor and softness.

It is impractical to test all new peach varieties released annually in the United States. Only those varieties which have descriptions indicating some possibilities of success in Mississippi are planted. Usually four trees of each variety selected for trial are planted. To reduce the locational soil problem these are set in two-tree plots which are separated as far apart in the orchard as possible. The tree spacing has been about 25 feet.

The orchards are located on hillsides and the tree rows are planted on top of broad base terraces. Clean cultivation is practiced in summer and winter covers of either native grasses or ryegrass have been used to reduce soil erosion to a minimum. These winter grasses are disced under as early in March or April as the weather permits.

Cultural Practices

The fertilization program begins shortly after the trees are planted. When the trees begin to grow, a half pound of 6-8-8 is applied in a circle about 12 inches from the trunk. This band of fertilizer should be 3 to 6 inches wide. In May or early June ½ pound of 16 percent nitrogen or its equivalent is applied in like manner.

Trees which have been in the orchard one or more years are fertilized twice annually. The first application is made in February or early March, before growth begins, so that the fertilizer becomes available to support early spring growth. The rates are one pound of 6-8-8 plus 1/8 pound of 16 percent nitrogen or its equivalent per tree per year of age. In June a second application of 1/8 pound of 16 percent nitrogen or its equivalent is made per tree per year of age to aid in summer growth and fruit bud initiation.

A 10-year-old tree would receive 10 pounds of 6-8-8 and about a half pound of ammonium nitrate in February and another half pound of ammonium nitrate in June. Trees which fail to develop good green color or a large number of shoots are given additional fertilizer. Commercial fruit growers adjust their fertilizer program so that they obtain a

Table 1. Peach fruit records from 1952 to 1959 at State College, Mississippi.

Variety	Ave. date first harvest	Number years fruited	Number fruits per bushel	Percent skin colored red	Stone freeness	Flesh color	Juice—percent soluble solids	Flavor	Recommendations*
Springtime	May 19	2	333	95	Semi	White		Fair	H, S
Mayflower	June 1	3	286	80	Cling	White	10.0	Fair	H
Hiland	June 8	6	196	90	Cling	Yellow	9.0	Good	C, S
Sunhaven	June 8	1	204	80	Cling	Yellow	11.5	Excellent	O
Erly-Red-Fre	June 12	7	192	70	Semi	White	9.9	Fair	C
Dixired	June 13	7	213	95	Cling	Yellow	9.8	Good	C
Cardinal	June 15	5	222	95	Cling	Yellow	10.2	Fair	C
Robin	June 16	4	244	95	Semi	White	18.0	Good	H, S
Goldray	June 17	2	208	40	Semi	Yellow	9.2	Fair	H
Maygold	June 17	4	208	90	Cling	Yellow	9.3	Fair	C, S
Redcap	June 19	4	196	95	Cling	Yellow	10.9	Fair	L, S
Coronet	June 20	4	213	80	Free	Yellow	10.1	Good	L
Dixigem	June 22	7	196	80	Free	Yellow	10.7	Excellent	C
Ranger	June 26	4	217	80	Free	Yellow	10.9	Excellent	L
Redhaven	June 26	7	208	80	Free	Yellow	11.9	Excellent	C
Sunrise	June 27	3	208	90	Semi	Yellow	9.5	Good	L
Golden Jubilee	June 29	7	213	50	Free	Yellow	11.3	Good	H
Triogem	June 30	7	200	70	Free	Yellow	12.2	Excellent	C
Keystone	July 1	2	167	80	Free	Yellow	10.0	Good	L, S
Richhaven	July 2	1	192	90	Free	Yellow	14.0	Excellent	O
Sunhigh	July 2	7	192	80	Free	Yellow	12.9	Excellent	L, S
Southland	July 4	6	175	90	Free	Yellow	11.4	Excellent	L, S
Burbank July Elberta	July 8	7	179	80	Free	Yellow	12.8	Good	L, S
Redglobe	July 8	2	182	80	Free	Yellow	11.1	Excellent	L
Ambergem	July 9	5	238	70	Cling	Yellow	12.1	Good	L
Halehaven	July 11	6	204	70	Free	Yellow	13.3	Excellent	C
Hiley	July 13	6	244	60	Free	White	9.7	Good	H, S
Loring	July 13	6	164	80	Free	Yellow	11.5	Excellent	L, S
Georgia Belle	July 15	7	213	50	Free	White	14.0	Excellent	L
Sullivans Early Elberta	July 15	5	169	70	Free	Yellow	13.3	Excellent	C
Blake	July 21	2	182	70	Free	Yellow	12.7	Excellent	O
Redskin	July 21	5	222	80	Free	Yellow	11.4	Excellent	L
Elberta	July 27	7	182	60	Free	Yellow	13.2	Excellent	C
Rio Oso Gem	August 2	5	192	80	Free	Yellow	12.0	Excellent	L
Late Elberta	August 12	5	182	50	Free	Yellow	13.5	Good	L
Frankie	August 15	2	213	60	Free	Yellow	14.5	Good	O
Aferglow	August 17	4	196	70	Free	Yellow	13.7	Excellent	L

*H—Home orchard only C—Commercial orchards L—Limited commercial trial O—Observation S—Chilling requirements suitable

A six-year-old peach tree with a spread of 17 feet.

good number of new shoots at least 18 to 24 inches long before midsummer. Fruit buds are formed on new shoots in midsummer and from these next year's crop will develop.

The peach trees have been pruned annually. Suckers and undesirable shoots are removed during the first two summers in the orchard. The purpose of training is to develop trees with the ability to produce large crops of good fruit. Winter pruning consists of training young trees to a moderately open center type with 3 or 4 primary limbs arising at different levels on the trunks with the trunk height being 18 to 36 inches. The purpose of annual pruning is to maintain vigorous, productive trees.

Mature trees are pruned moderately with about 1/3 of the preceding season's growth being removed. This encourages new shoot growth on which the following season's fruit is produced.

The pest control program includes annual application of Di-Chlor-Mulsion in the fall to control peach tree borers. Annually a dormant spray of oil emulsion is used to control scale insects. The summer spray program to control fruit insects and diseases is followed as outlined in the Mississippi Spray Calendar.

Information in Table 1 is based on records made annually from 1952 through 1959 except for 1955. In March 1955 a late freeze killed all fruit buds in the orchards. The winters of 1951-52 and 1956-57 were unusually warm at State College. Insufficient chilling hours were received by the trees to fully break the rest period of varieties with high chilling requirements. Prolonged dormancy resulted with these varieties and the ripening dates were somewhat later than usual.

Results Shown As Averages

Figures given in Table 1 represent averages for the number of years that fruit records were made on each variety. The results from 6 to 7 years are naturally more representative of the ultimate performance of a variety than results from fewer years observations.

One of the most important characteristics of a variety is the date of ripening. A peach grower for roadside or local markets may select varieties with a ripening sequence to provide ripe fruit continuously from early June to mid or late August. The dates shown in Table 1 are for the average first harvest. These dates may vary as much as a week or more in either direction from average. Causes of variation can be such factors as prolonged dormancy, very early spring bloom, very cold weather in early spring and other weather variables. The nitrogen fertilizer applied in spring also influences the date of ripening. Heavy nitrogen applications delay ripening. With very heavy rates of application the dates can be delayed 10 days or two weeks. This is not a recommended practice because it results in fruits with less coloration, and therefore, they are less desirable for market.

Flesh color is of primary importance when peaches are grown for market. The national peach markets usually prefer yellow-fleshed peaches. There are only a very few commercial exceptions. Growers catering to local markets might develop very strong demand for white-fleshed peaches with unusual qualities such as the excellent texture and flavor of Georgia Belle and the fine, attractive appearance of Erly-Red-Fre.

In general, early-ripening peach varieties are clingstone or semifree,whereas, later ripening varieties are freestone. The markets prefer fruit of freestone varieties when it is available. Clingstone varieties which ripen in midseason or later must be sold for specialized purposes such as clingstone pickles.

Size and Color

Two primary factors contribute to the sale of fresh peaches—attractiveness and size. The attractiveness, or consumer eye-appeal, is influenced by the amount of skin colored red as well as by color intensity, shape of fruit and lack of dull fuzz. The present day national peach markets are tending to prefer bright red peach colors as exemplifed by Dixired and as contrasted to Golden Jubilee.

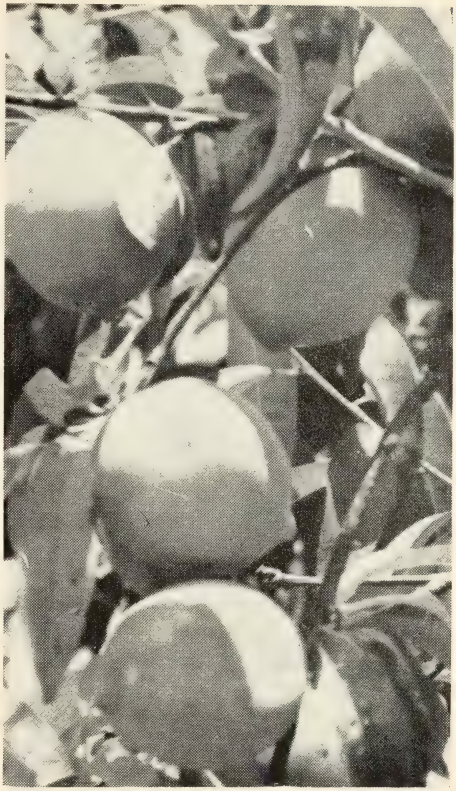
The peaches have been thinned annually in an attempt to keep the mature fruits from touching each other. The number of fruits per bushel shown in Table 1 has been calculated from the weight of 20 peaches which has been recorded from each plot at each harvest date. Some varieties normally produce larger fruits than others even though the thinning is applied with equal severity.

The soluble solids as shown in Table 1 represent average readings with a Bausch and Lomb hand refractometer. In general the early ripening peaches have less "sugars" and therefore, have a watery taste. The highest soluble solids content of the fresh juice from "tree ripe" peaches may not have the sweetest taste. This is true because the taste is based on a sugar-acid ratio in which a variety with medium sugar-low acid might taste sweeter than a high sugar-high acid variety.

In the period from 1952 to 1958, 138 named varieties of peaches were fruited at State College. Only 37 of these are listed in Table 1. These varieties provide a wide range of fruit characteristics and ripening seasons and most growers can easily choose suitable varieties from the list. The recommendations made in the last column are also based on knowledge of the commercial use and adaptability of varieties.

Varieties Classified

Each variety listed could be used for home or local market needs to meet specialized demands. However, those with a home (H) recommendation in general have not been tested sufficiently well or have faults which would not warrant widespread use for commercial markets. Those varieties listed for limited commercial trial (L) and for observation (O) may in the future merit full recommendation for commercial use.



Georgia Belle peaches ready for harvest.

In order not to mislead growers in South Mississippi a recommendation is made for varieties with low chilling requirements to break the rest period. These are marked with an "S" (south). Growers in this area of Mississippi will greatly improve their chances for success in peach growing by selecting these varieties.

Table 2 lists peach varieties which have been tested but are not recommended for general use because of one or more shortcomings such as poor color, flavor, shape, low tree vigor and many other faults.

Growers who would like to obtain specific varietal recommendations for either a large orchard or only a few trees can write the author for assistance.

The peach variety testing work is being continued at Mississippi State University in order to provide valid information for varietal selections by growers in the future.

Table 2. Varieties of peaches which have been tested but are NOT recommended for wide-spread general usage.

Alton
Arp Beauty
Augbert
Best June
Blazing Gold
Brackett
Carman
Chinese Cling
Colora
Delicious
Dixigold
Double Delight
Early Halehaven
Early Hiley
Early Rose
Fair Beauty
Fairhaven
Fertile Hale
Fireball
Fireglow
Fisher
Geheb
George Walters
Gold Dust
Golden Globe
Golden Sweet
Good Cheer
Halberta Giant
Halegold
Hale Harrison Brilliant
Hardy Berta
Indian Blood
Jerseyland
July Heath
Kalhaven
Late Crawford
Laterose
Luton
Marigold
Mikado
Missouri
Orchid
Oriole
Osage
Ozark
Pacemaker
Polly
Prairie Dawn
Prairie Daybreak
Pres. Roosevelt
Redbird
Redcrest
Romance
Salberta
Santa Rosa
Saturn
Shinn's Delicious
Smith
Southern Glow
Starking Delicious
Stark Sure-Crop
Summercrest
Sunbeam
Sunday Elberta
Sungold
Tulip
Valiant
Valigold
Vedette
Vetern
Weldon
White Hale

BULLETIN 587 JANUARY 1960

Educational Programs For Increasing Milk Drinking Among Women

A Pilot Study

JUN [illegible] 1961

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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ACKNOWLEDGEMENT

The authors wish to express appreciation to the Home Demonstration Agents of the Mississippi Extension Service who cooperated in this report and to the individual women who participated.

Educational Programs for Increasing Milk-Drinking Among Women*

A PILOT STUDY

By DOROTHY DICKINS and VIRGINIA FERGUSON

The purpose of this study was to determine the relative effectiveness of four types of education programs for increasing milk drinking among women.

Approximately two-thirds of the homemakers interviewed in a previous study made in two typical small cities and two villages in Mississippi stated that they did not usually drink milk as often as once a day. Two-fifths had not drunk any during the week preceding the interview. In the same study it was found that the total consumption of milk products was higher in those families in which the homemaker was a daily milk drinker.[1]

Milk is a leading source of calcium and an important contributor of riboflavin and high quality protein. It also provides other vitamins, minerals, carbohydrates, and fats. When fluid milk or its equivalent in other forms is omitted from the day's meals or used only in small amounts, calcium and sometimes riboflavin are likely to fall below amounts recommended for good nutrition.[2]

Most techniques for increasing milk consumption have been centered on increased sales or on the family rather than on a special group of consumers. A type of study which seemed to hold great possibilities for providing insight into the present problem was one developed by the social scientist Kurt Lewin. Preliminary studies made by him and his co-workers include a comparison of a lecture method for changing food habits with a method of group decision and that of group decision with a request.[3], [4], [5].

Scope of Study

Six Mississippi urban Home Demonstration clubs were chosen for experimentation in the present study. They were visited in January and again in February, 1958. As a total of only 79 women participated, it was decided to try the same methods again in six different clubs in February and March, 1959. A total of 146 women were included in all. The number participating in individual clubs is shown in the Appendix, Section I.

For the purposes of this report, the women of each two clubs in which the same method was employed are considered as one group. Methods used, locations of clubs, and number in the groups were as follows:

Method	Locations of clubs	Number of women in method group
Lecture*	Tupelo; Yazoo City	19
Lecture-Request*	Columbus; Greenwood	27
Discussion*	Tupelo; Vicksburg	33
Discussion-Decision*	Columbus; Yazoo City	27
Tasting only	Columbus; Jackson	22
Control	Tupelo; Yazoo City	18
	Total:	146

*Chilled samples of milk were also served.

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*This is a sub-project of the Southern Regional Project SM-13 Revised.

[1] Dickins, Dorothy and Virginia Ferguson, **Dairy Products Consumption and the Market, Four Mississippi Towns,** Mississippi Agricultural Experiment Station Bulletin 542, April, 1956.

[2] **Essentials of an Adequate Diet, Agricultural Information Bulletin 160,** Agricultural Research Service, United States Department of Agriculture, November, 1956.

The Four Methods, "Tasting Only", and Control

On the first visit to a Home Demonstration club meeting, a staff member of the Home Economics Department of the Mississippi Experiment Station distributed a short questionnaire to the women present, including members and guests. They were instructed to write down "just the honest truth" concerning quantities of various kinds of fluid milk they had drunk during the preceding week whether or not they felt that they should drink more, and if so, why they did not.[6]

Procedures then varied in the clubs according to methods as follows:

Lecture: The Experiment Station staff member gave a talk or "lecture". It concerned (1) the principal components of milk; (2) why women need it; (3) the fact that recent dairy products consumption studies show that Mississippi women are not getting enough; (4) objections to milk given in interviews; and (5) suggestions as to how milk-drinking habits can be improved.[7]

Chilled samples of three types of milk —homogenized milk, liquefied dried milk, and a half-and-half mixture of homogenized and liquefied dried—were then served to all women desiring to taste them. Those who had not drunk any of the particular type of milk being served in the preceding six months were especially urged to try a sample.

After the tasting session, the women completed a second form stating facts they had learned about milk and other impressions of the program.

Lecture-Request: The procedure described above was followed also in the Lecture-Request clubs. After completion of the second form, however, the Experiment Station home economist made a "request" asking those who didn't usually drink any milk at all to try to begin, and those who were already drinking a little to increase.

Discussion: In the discussion clubs the home economist gave a brief introduction consisting of the first four parts of the lecture. She then encouraged members with milk-drinking problems to discuss them, and others to suggest solutions. She contributed to the discussion herself by bringing out points not mentioned by the women.[8]

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[3] Lewin, Kurt, **Forces Behind Food Habits and Methods of Change.** Reprinted from "The Problem of Changing Food Habits," a report of the Committee on Food Habits of the National Research Council, Washington, D.C. (National Research Council Bulletin 108, October, 1943.)

[4] Willerman, Ben, directed by Kurt Lewin, **Group Decision and Request as a Means of Changing Food Habits.** Child Welfare Research Station, State University of Iowa. Mimeo report by National Research Council, 1942.

[5] Lewin, Kurt, **The Relative Effectiveness of a Lecture Method and a Method of Group Decision for Changing Food Habits,** Mimeo report, Committee on Food Habits, National Research Council, 1942.

[6] Numbers were used by the women instead of names on all forms filled out during the study.

[7] A copy of the talk given, as well as details as to the Lecture-Request, Discussion and Discussion-Decision methods may be obtained by writing to the Home Economics Department of the Mississippi Agricultural Experiment Station.

[8] Objections to milk made by the women in the Discussion and Discussion-Decision clubs included the following: "Turns my stomach"; "Have heard that it causes arthritis"; "Causes face to break out"; "The idea that it comes from an animal with hair on it"; "When dairies run short, they dilute the milk"; "Tastes dirty"; "What about idea of milk causing hardening of the arteries?"; "Don't like the smell."

Suggestions made by the women for overcoming problems and comments supporting milk-drinking included the following: "Got husband to drink it by putting chocolate in it"; "Put milk glasses in refrigerator freezing compartment right before dinner"; "I drink four to five glasses a day"; "Drink milk with a straw. Put straw way back in mouth so can't taste as well"; "As you grow older you need more milk to strengthen the bones."

Milk samples were distributed for tasting and forms completed concerning what had been learned about milk.

Discussion-Decision: The procedure followed in the Discussion-Decision clubs was the same as in the Discussion clubs. In these clubs, however, an additional question was added to the second questionnaire in which the women were asked to check the amount of milk each would try to drink per day in the future. Categories available for checking were as follows: 1 pint (2 cups); 3/4 pint (1½ cups); ½ pint (1 cup); one small fruit-juice glass (½ cup); or none.

The home economist finally suggested that an increase in milk-drinking be made a club goal or project. Women in both clubs voted to do this.

Tasting only: In these clubs the first form was filled out as in the "program" clubs. The "demonstration" for the meeting, however, was presented by the home agent or club program leader on a subject **not** pertaining to milk. The Experiment Station home economist then served the three milk samples.

Control: There was no program concerning milk or tasting of samples in the Control clubs. After the preliminary form was completed, regularly - scheduled demonstrations not pertaining to milk were given by the home agent.

All of the clubs were visited by the same Experiment Station staff member. At none of the clubs was there a statement made that there were plans for a revisit or checkup of any kind in the future.

Second Month: The following month clubs were revisited and the women asked to complete a form which included a question concerning quantities of milk drunk during the preceding week. The women were cautioned as they had been before replying to questions at the first meeting to write down just the "honest truth." They were asked whether or not they had made any changes in their milk-drinking habits during the preceding month, and if they had, to describe them. They stated whether or not the previous month's club meeting had had any effect on their making changes, and about how long they thought changes would last.

In addition, they gave certain basic information about themselves and their families, such as age, education, family size, income, and source of fresh milk supply.

Women who had completed forms at the first month's meetings who were not present at the second meetings were visited in their homes. Those present at the second meetings only were excluded from the study.

Description of Women in the Clubs

All participants were white women living in or within the immediate vicinity of six Mississippi cities. All but four (3 percent) had attended high school at least.[9] There were variations among the groups, however, in education, age, family size and income. (See Tables 1-3 in the Appendix.)

There were relatively more women in the Lecture, the Discussion, and the Control groups who had had college training. The Discussion - Decision group had fewest with college training. The Lecture and Lecture-Request clubs had relatively more older women; the Control group relatively more younger. Families of women in the Discussion and Control groups had highest incomes. Lowest incomes were found among those in the

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[9] As a whole, members of groups studied had had more schooling than the average for white women in urban areas of the state, 23 percent of whom (according to the 1950 census) have not attended high school. The percentage of women in this study having high school training (9 through 12 grades) was 68 and the percentage having college training (13 grades or over) was 29. Percentages for all white urban women in the state (1950 census) were 53 and 24, respectively. However, from an educational standpoint, the women included in the study are probably typical of those who are members of organized clubs such as these in Mississippi cities.

Discussion - Decision group.

Milk was obtained by purchase by almost all of the women in the study (95 percent) as would be expected in urban clubs. Urban clubs were used in this particular study since one purpose was to determine the effect of the programs on the market for milk.

Quantities of Milk Drunk and Attitudes Before Programs were Conducted

Quantities of milk reported by the 146 women as having been drunk during the week preceding the first meetings ranged from none whatever to 30 cups.[10]

Sixteen percent reported that they had not drunk any during the week; 41 percent had drunk from one to six cups; 27 percent, from seven to 13 cups; and 16 percent, 14 cups or more.

Milk-drinking habits were better among these club women than among those in cross-section samples interviewed previously by the department. However, as shown above, over one-half had drunk an average of less than one cup per day.[11]

There was variation among the method groups in quantities reported for the week before these first meetings, as well as in replies to the question, "Do you think you should drink more milk than you do?", as shown in Table 1. These questions were asked before the lectures and discussions in the program clubs.

Averages for the week ranged from 4.9 cups per person in the Lecture group to 8.4 cups in the "Tasting only" group. The majority stated that they thought that they should drink more milk, although a large proportion, especially in the Discussion - Decision group, did not feel a need for increasing.

Reasons given most frequently for not drinking more were a dislike of milk and preference for other beverages, principally coffee. Many wrote that milk was fattening (or that they were trying to reduce); that it caused constipation or allergies. Other statements made were: "Don't think of it"; "Don't take the time"; "Expensive"; "Use in cooking".

Facts Learned About Milk, First Meeting

On the questionnaire distributed after the programs at the first meetings, the following percentages in the respective groups stated that they had learned something about milk that they had not already known: Lecture, 79; Lecture-Request, 67; Discussion, 42; Discussion - Decision, 56. It is interesting to note that in the two program groups where there were most older women (Lecture and Lecture-Request), more "new things" had been learned.

In telling what they had learned and other impressions of the program, about

Table 1. The average number of cups of milk reported as having been drunk during the week preceding the first meetings and percentages of members who felt that they should drink more, classified by method group.

Method groups	Amount drunk past week	"Think that I should drink more"
	Average	Percent
Lecture (N = 19)	4.9 cups	74
Lecture-Request (N = 27)	6.0 cups	56
Discussion (N = 33)	5.8 cups	70
Discussion-Decision (N = 27)	5.9 cups	26
Tasting only (N = 22)	8.4 cups	46
Control (N = 18)	6.7 cups	61
Total (N = 146)	6.2 cups	55

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[10] Quantities were stated in terms of glasses cups, and pints. One glass was adjudged to be equivalent to one cup.

[11] The minimum amount of milk recommended by nutritionists for adult women per day is two cups, part of which can be obtained in cheese, ice cream and in cooked dishes containing milk. Information concerning consumption of these foods was not obtained in this study.

Table 2. Percentage change in total number of cups of milk drunk by the women during the two report weeks; and average number cups drunk the second report week, classified by method groups.

Method groups	Comparison of the total cups drunk during the week preceding second meeting with that preceding the first**	Average per member second report week
Lecture (N = 19)	12 percent increase	5.5 cups
Lecture-Request (N = 27)	16 percent increase	7.0 cups
Discussion (N = 33)	33 percent increase	7.8 cups
Discussion-Decision (N = 27)*	29 percent increase	7.6 cups
Tasting only (N = 22)	9 percent increase	9.2 cups
Control (N = 18)	3 percent decrease	6.4 cups

*Two members of this group stated that the drinking glasses which they had used the second week were large glasses. These were counted at 1¼ cups instead of one cup as were the others, assumed to be ordinary glasses.

**According to statistical tests, there is a significant relationship at the 1% level of increase in total cups between the two discussion, two lecture and two non-program methods.

one-third made general statements such as, "more about the importance of milk, that I should drink more milk, etc." Comments concerning the mixing of dry and whole milk were next in frequency. Facts learned about dried milk—that it is high in food value, tastes good, etc.—were stated by about 16 percent of the women—by more in the Lecture and Lecture-Request clubs than in the others.

From three to six women in each of the program groups expressed surprise at the statement made that so few women drink milk. A number made complimentary comments concerning the lecture or the discussion.

Goals Set By Individuals in The Discussion-Decision Group

At the conclusion of the first meeting over three-fourths of the Discussion-Decision group members checked that they would try to drink in the future a higher quantity of milk than that reported for the preceding week. For the group as a whole, the intended future increase in total cups was 57 percent compared with that drunk the previous week.

Comparison of Quantities of Milk Drunk During the Second and First Report Week

The percentage change in total number of cups of milk drunk by the women during the two report weeks is shown in Table 2.

Overall increases in the four program groups ranged from 12 to 33 percent. Members of the "Tasting only" group, as a whole, increased 9 percent; those in the Control group made a slight decrease. Increase in total cups, compared with the week before the first meeting, was greatest in the Discussion and Discussion-Decision groups, approximately two cups per member.

It is interesting to compare results in the Lecture group with those in the Discussion group. The percentages who stated before the programs that they thought that they should drink more milk were about the same in the two groups. A much higher proportion of Lecture group members stated that they had learned something about milk at the meeting. Yet, overall increase was almost three times greater in the Discussion group than in the Lecture.

"Decisions" made by Discussion-Decision group members to drink certain quantities of milk in the future did not affect them to the extent that they increased more than women of the group limited to discussion only. In fact, proportionate increase in the Discussion - Decision group was slightly less. Over half (57 percent) of the members of this group did not drink as much milk during the week preceding the second club meeting as the quantity checked one month before.

Table 3. Percentages of members in each of the six method groups who increased and decreas amounts of milk drunk during the second report week as compared with the first, and mean cu increased and decreased.

Method groups	Percent of women who increased	Percent of women who decreased*	Mean cups increased by those who increased	Mean cup decreased b those who decreased
Lecture (N = 19)	37	37	5.9	4.3
Lecture-Request (N = 27)	41	30	5.5	3.0
Discussion (N = 33)	52	18	4.6	2.5
Discussion-Decision (N = 27)	52	15	4.3	3.8
Tasting only (N = 22)	45	36	4.0	2.9
Control (N = 18)	22	39	4.8	3.3

*The remaining percentage of women drank the same quantity during the second report wee as during the first.

Comparison of Number of Individuals Increasing and Decreasing

In all groups there were individual members who drank less milk the second week than the first, those who drank the same quantity, and those who drank more. In Table 3 are shown the percentage of members of the various groups who increased and decreased, and average amount.

A relatively higher percentage of women in the two types of discussion groups increased amounts of milk drunk during the second report week. A relatively lower percentage decreased in these groups.

In the Lecture group, the average number of cups increased by those increasing was highest (5.9), but the average decreased by those decreasing (4.3) was also highest. Exactly the same number of women drank more milk as drank less. Another fact to be noted is the low percentage of women in the Control group who increased quantities the second period.

Types of Milk in Which Changes Occurred

While this study is concerned primarily with increases in the drinking of fluid milk in general, members were asked to specify at both meetings quantities of particular kinds they had drunk. The relative percentages of the various types consumed are shown in Table 4 in the Appendix.

In all four program groups the propo tion which was whole milk was low during the second report week and th proportion which was dried milk was hig er. Use of the "mixture of fresh an liquefied dried" was relatively great the second week in three of the progra groups. Discussion group members dran a lower percentage of the mixed milk but increased proportionate buttermilk in take. The lower price and lower fat co tent of dried milk, buttermilk, and th dried and fresh mixture were stressed i the program clubs. This no doubt explai somewhat the proportionate increase i these milks.

In the "Tasting only" group, the pe centage of various types drunk durin the two periods was about the same. Co trol group members as a whole increase fresh sweet milk intake and decrease consumption of other types.

Verbal Responses Concerning Change Made Preceding Month

While a comparison of the two repo weeks provides some insight into the rel tive effectiveness of the methods, w should bear in mind that even individua with "regular" milk - drinking habi would probably be expected to vary sligh ly in quantities and kinds of milk the drink from time to time. It is possibl also, that factors other than the club pr grams would have been responsible f some of the changes.

For these reasons, the women of the tudy were given an opportunity at the econd club meeting to state whether or not they had made any changes in milk-drinking habits during the preceding month; if so, to describe the changes and o state whether or not they were a result of the meeting. If not, they described reasons for the change.

Changes described included the drinking of more milk (or beginning, when none had been drunk before); trying a different kind; and in a few cases, drinking less milk. The proportion of women in the six method groups who stated that they had made changes the preceding month ranged from approximately one-fifth in the Control group to one-half in the Discussion group. Table 5 in the Appendix shows the percentages of women making changes during the month and kind of change.

All changes reported in the two types of lecture clubs were stated to have been the result of the club meetings, but some made in other groups were attributed to other causes. All decreases were reported to have been the result of factors other than the meeting.

Changes Attributed To Influence of Club Meetings

As we are particularly interested in the influence of the club programs, we should examine the percentages who stated that the meeting had affected them. These are shown in Table 4.

In the Lecture-Request clubs were found the largest proportion, about two-fifths, who stated that the meeting had influenced them to make changes of all kinds during the preceding month. According to these replies, the meeting affected about one-third in the Lecture, the Discussion and the Discussion-Decision groups. One person in the "Tasting only" group stated that she had drunk more milk as a result of tasting the milk samples and another that filling out the form at the first meeting had influenced her. One Control group member stated also that she had increased as a result of answering questions on the form.

The largest percentage mentioning that they had drunk more milk as a result of the meeting was in the Discussion group, as all changes said to have been the influence of the meeting were increases.

Practically all who reported that the program had led to increases in milk-drinking predicted that these changes would last quite awhile or indefinitely.

Changes Not Attributed To Meetings

The largest proportion of changes made during the month which were said not to have been the result of the meetings were increases because of illness, pregnancy, dentist's recommendations, etc. One woman had been influenced by TV and radio advertising.

Some stated that during the past month they had decreased the quantity of milk drunk. One was drinking more iced tea.

Table 4. Percentages of women in the six method groups who stated that they had made changes during the preceding month as a result of the club meeting and types of changes.

Method groups	Last month's meeting had an effect on my making a change	Type of change* (By those whom the meeting influenced only)	
		Drank more	Drank a different kind
	Percent	Percent	Percent
Lecture (N = 19)	32	19	26
Lecture-Request (N = 27)	41	26	22
Discussion (N = 33)	33	33	0
Discussion-Decision (N = 27)	33	22	11
Tasting only (N = 22)	9	5	9
Control (N = 18)	5	5	0

*Some named more than one type of change.

One who ordinarily had home-produced milk said her cow was "dry." One had been living away from home and eating meals out.

Summary and Conclusions

This was a study to determine the relative effectiveness of four types of educational programs for increasing milk-drinking among white urban home demonstration club women. The programs were (1) a lecture followed by the tasting of milk samples, (2) the same lecture and tasting of samples followed by a request to drink more milk, (3) a discussion entered into by the women with important points contributed by the discussion leader and followed by a tasting session, (4) a similar discussion and tasting of samples followed by a "decision." Members checked the quantity of milk they would "try" to drink in the future and voted to make an increase in milk-drinking a club goal.

An additional group did tasting only. Another group served as a control. Members were not told that there would be a revisit in the future. In all, 146 women in 12 clubs (two for each program group studied) participated. There was variation among groups in education, income, and in milk-drinking habits prior to the experiment.

The same women completed forms one month later. According to total quantities of milk drunk the second report week compared with the first, increases ranged from 12 to 33 percent in the program clubs. The highest percentages of increase were in the two groups in which discussions had been conducted. In these two groups a higher proportion of individuals increased and a much lower proportion decreased.

From 32 to 41 percent of the women of the program groups reported verbally that the club meeting had influenced them to increase and/or change kinds of milk drunk during the month. The highest proportion reporting both types of change was among Lecture-Request group members. A relatively higher percentage in the Discussion group stated that they drank more milk as the result of the program.

In the two non-program groups, quantities reported and verbal responses revealed only slight change.

While a greater increase in milk-drinking was made by Discussion group members than by those of the Discussion-Decision group, it should be noted that both income and educational level in the latter was lower, as was the percentage who felt that they should drink more milk at the beginning of the first meeting. It is possible, therefore, that changes made by members of the Discussion - Decision group are of greater significance.

The limited number of cases and variations in characteristics of group members in this study prevent the making of broad implications from the data. Certain results should be of interest, however, to those concerned with the changing of food habits, as well as to educators in other fields. More change took place when the women were given samples of milk to taste than when they were not given milk. More change took place when they participated in discussions than when they merely listened to a lecture or were asked to drink more milk in the future.

APPENDIX

I. The number of women included in individual Home Demonstration clubs:

Method groups	January and February, 1958		February and March, 1959	
	Location of club	Number of women participating	Location of club	Number of women participating
Lecture	Tupelo	15	Yazoo City	4
Lecture-Request	Columbus	19	Greenwood	8
Discussion	Tupelo	10	Vicksburg	23
Discussion-Decision	Columbus	14	Yazoo City	13
Tasting only	Columbus	11	Jackson	11
Control	Tupelo	10	Yazoo City	8
Total		79		67

II. Tables

Table 1. Ages and education of women in each of the six method groups.

Method groups	Ages			Education		
	Percent of women who were:			Percent of women who had attended		
	Under 40 yrs.	40-49 yrs.	50 yrs. & over	8th grade or less	9-12 grades	1 or more years college
Lecture (N = 19)	16	26	58	6	47	47
Lecture-Request (N = 27)	26	19	55	4	67	29
Discussion (N = 33)	27	46	27	0	64	36
Discussion-Decision (N = 27)	41	33	26	4	89	7
Tasting only (N = 22)	41	41	18	5	77	18
Control (N = 18)	83	11	6	0	61	39

Table 2. Size of families of women in each of the six method groups.

Method groups	Percent of women with families of:		
	1-2 persons	3-4 persons	5 or more persons
Lecture (N = 19)	31	53	16
Lecture-Request (N = 27)	33	52	15
Discussion (N = 33)	30	52	18
Discussion-Decision (N = 27)	18	56	26
Tasting only (N = 22)	23	63	14
Control (N = 18)	17	44	39

Table 3. Percentage of women from families with specified family and per capita incomes* during past year, classified by method group.

Method groups	Percent of women from families with:				Percent who did not report income
	Family income		Per capita income		
	Under $5,000	$5,000 or over	Below $1,800	$1,800 or over	
Lecture (N = 19)	53	31	42	42	16
Lecture-Request (N = 27)	52	41	59	33	7
Discussion (N = 33)	21	70	21	70	9
Discussion-Decision (N = 27)	59	41	70	30	0
Tasting only (N = 22)	45	50	59	36	5
Control (N = 18)	17	78	39	56	5

*Members were given the following ranges and asked to "check the income group which best describes your family the past year before tax deductions": Under $2,500; $2,500-$4,999; $5,000-$9,999; and $10,000 and over. Per capita income was derived by dividing the midpoint of the income range by the number of members in the economic family the past year. For the range "Under $2,500," $1,250 was used as the midpoint; $12,500 was used as the midpoint for the range, "$10,000 and over."

Table 4. Relative percentage of milk of specified kinds drunk by women in the six method groups during the two report weeks.

Method groups	Percentage of total cups which was:							
	Fresh sweet, (whole, skimmed, chocolate, cocoa)		Fresh buttermilk		Dried milk (as sweet or buttermilk)		Mixture of fresh and liquefied dried	
	1st week	2nd week	1st week	2nd week	1st week	2nd week	1st week	2nd week
Lecture	86	67	10	17	0	3	4	13
Lecture-Request	86	70	5	4	5	11	4	15
Discussion	81	79	9	13	4	6	6	2
Discussion-Decision	89	82	10	9	1	5	0	4
Tasting only	81	82	5	6	9	8	5	4
Control	70	87	14	8	9	2	7	3

Table 5. Percentages of women in the six method groups who stated that they had made changes in milk-drinking habits during the preceding month and percentages making specified changes.

Method groups	Have made changes past month	What changes?*		
		Have drunk more milk	Have drunk less milk	Have drunk a different kind
	Percent	Percent	Percent	Percent
Lecture (N = 19)	32	19	0	26
Lecture-Request (N = 27)	41	26	0	22
Discussion (N = 33)	51	42	9	0
Discussion-Decision (N = 27)	41	22	4	15
Tasting only (N = 22)	23	9	5	14
Control (N = 18)	22	17	0	6

*Some named more than one type of change.

BULLETIN 588 JANUARY 1960

Watermelon Transplants

For Healthier, Earlier, and More Profitable Crops

MITCHELL MEM
APR
MISSISSIPPI STATE UNIV

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

ON THE COVER:

Figure 1. Watermelon and cantaloupe transplants grown in the greenhouse of the Department of Plant Pathology and Physiology. In the foreground and background are shown larger vines and fruits grown for breeding purposes.

WATERMELON TRANSPLANTS FOR HEALTHIER, EARLIER AND MORE PROFITABLE CROPS

Bv S. S. IVANOFF, R. C. ALBRITTON.
CLYDE L. BLOUNT, and B. E. WAGGONER

Watermelon growing is an important enterprise in Mississippi. Efforts are being made by the Experiment Station to make raising this crop more extensive and more profitable. Control of diseases is the chief problem. Along with breeding and testing new varieties, a new approach has been attempted in advancing the culture of this crop. This is the use of young transplants raised in various kinds of pots. By this method of growing watermelons the following benefits are sought:

1. **To insure a good stand by avoiding seed and seedling rots.** Loss of stand is a common experience. Replanting increases the cost of production and, most of all, sets the maturity of the crop back. Watermelon seed are very susceptible to rotting caused by various soil-inhabiting microorganisms. Seed treatment has not been as effective as with other crops. Replanting has been a frequent necessity.

2. **To avoid weeds by getting a head start.** Weeds "choke" the young plants. Besides being expensive, removal of weeds may not be possible if the ground stays wet.

3. **To produce earlier crops and obtain higher prices.** Any method which helps to produce an earlier crop in Mississippi will usually benefit the grower by getting a higher price. Getting the crop harvested earlier reduces hazards from diseases, insects, and weather.

4. **To control some foliage diseases and insects, by treating transplants with fungicides and insecticides, before they are set out in the field.** Some disease problems have been met by use of disease-resistant varieties. Nematodes remain a problem in some areas, while cucumber beetles and other insects, besides destroying the young plants, also seem to transmit certain diseases, particularly gummy stem blight and viruses, for which no practical control is now available. Any protection that may be given the young plants to give them a good start would be useful. This can be more easily and cheaply done before transplanting, while the plants are still in a close group. In a few minutes enough plants may be sprayed or dusted to plant several acres.

Envisaged in this program is the eventual incorporation, within the soil in the pot, of certain systemic fungicides and insecticides to give protection to the plants for considerable time after transplanting.

5. **To make practicable the use of hybrid seed.** Since one average-size watermelon contains more than enough seed to plant an acre, if one seed is planted per pot, then the use of first generation hybrid seed becomes practicable from the standpoint of seed expense. (By the common method of direct seeding a grower usually needs a pound of seed for planting and replanting an acre.) Hybrid seed would be advantageous because many desirable characteristics of the watermelon are inherited in a dominant manner. Such outstanding qualities as resistance to diseases, earliness, eating qualities, and many other traits may be combined in the first hybrid generation by crossing two selected parents without the necessity of further breeding.

Furthermore, hybrids are outstanding for uniformity in maturity, size, shape, quality, and other traits. Although we now have good quality watermelons, future demands of trade are likely to be varied and unpredictable. However, a great many first generation hybrids may be produced to satisfy diverse consumer needs and fancies. Production of hybrid seed could eventually become a commercial occupation.

More research in the direction of the study and the massive use of transplants

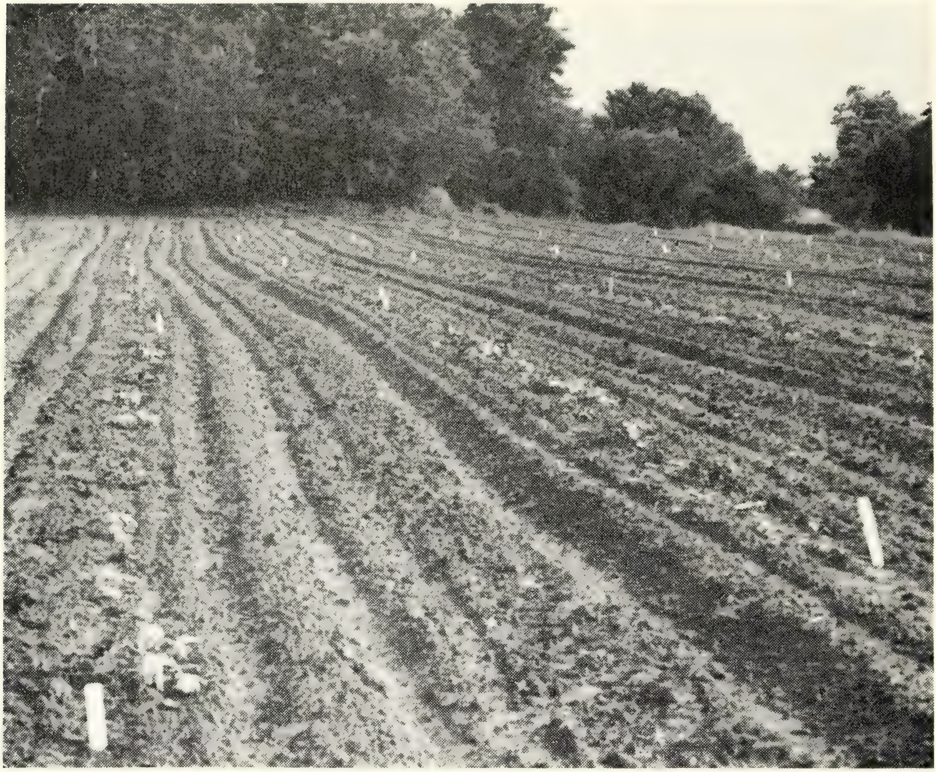

Figure 2. Watermelon vines shortly after transplanting. Notice absence of weeds.

for row crops may be anticipated. Improving existing methods and searching for new techniques in treating transplants hitherto difficult, or expensive to accomplish, must be one of the first objectives.

The following is an account of experience gained and progress made thus far in the directions outlined, using watermelons and, in some instances, cantaloupes as test plants.

Raising The Transplants

For the experiments reported here all transplants were raised in the greenhouse at Mississippi State University. Previous experience was gained in transplanting watermelons and cantaloupes for a number of years in connection with the breeding work. At first ordinary clay pots were used, 4- and 6-inch sizes. Later other types were employed, made of more or less easily decomposable material, such as porous paper, peat moss, or animal manure, all pressed into suitable shapes and sizes. All of these types are now sold commercially and are advertised in seed catalogues and farm journals.

In testing these various pots it was found that some had advantages over others. Clay pots have the disadvantage of producing root binding. They would also be inconvenient for machine transplanting, the use of which was contemplated in connection with this project. On the other hand, when the plants were taken to the field at the right stage, before too much root binding had taken place, clay pots were found quite satisfactory.

Perishable containers allow the roots

to grow through them and thus avoid undesirable root binding to a considerable extent. In this type of pot the plants may be kept longer before transplanting if weather conditions should be unfavorable, and this is an important consideration.

The best pots were found to be those made of cattle manure, followed in preference by the peat moss and paper pots. In the commercial "Ferto-Pots" (cow manure) the watermelon and cantaloupe plants grew stockier, greener, and had a better root system than in any other kind of tested pots. Improvements may be made with other pots, however, if organic matter and other nutrients are added to the potting soil. The soil used was medium heavy in consistency, with some sand and organic matter added for better drainage. The most suitable size for watermelons was a four-inch pot, but a smaller container may also be satisfactory. Using a three-inch pot, an area of only 30 square feet will be necessary to grow enough transplants to plant one acre of watermelons.

A single seed was ordinarily planted in each pot. The plants were started about four to six weeks before transplanting time. At this stage they have become well established in the pot but are not yet ready "to run." Some hardening of the transplants is of help. Time may be saved in raising the plants if the seed are kept in a warm, wet "rag doll" for 24 hours prior to planting.

Plants were grown at temperatures varying from 70° to 80° F during the day. Temperatures above 90° made the plants grow spindly and are to be avoided. On the other hand, temperatures below 65° F will retard germination and the seeds may rot before any stand is produced.

The time for transplanting is after the danger of frost has passed.

The question arises: How would the average grower raise his plants if he had no greenhouse? Until a grower obtains the services of a greenhouse, plants may be raised in cold frames or hot beds like other transplants, such as tomatoes, peppers, cabbage, etc. Certain indoor conveniences may also be adapted by providing sufficient artificial lighting and ordinary temperature control. Enough artificial light, combined with some day light, is necessary to maintain a good green color of the leaves. Before any large-scale transplanting work is attempted, a grower should do some experimenting himself in order to learn firsthand how to handle such plant material. Eventually these transplants may be raised in quantities by commercial greenhouses, if sufficient demand is made for them.

Some disadvantages in growing watermelons from transplants are to be expected, such as the cost of raising the plants and the necessity of using water at transplanting, and often after transplanting, if rains do not come to help the crop get established. **It is very important that a close contact is maintained between the potted plant and the soil surrounding it for several days after transplanting. This** latter condition will ease the "shock" and will insure the success of the transplanting.

Transplanting Experiments in 1958

Three replicated trials were made at three branch experiment stations (Poplarville, Newton, and Verona) to compare maturity and yields from transplanted vs. directly-seeded watermelons. (A fourth trial at Yalobusha County with a private grower was abandoned to the weeds because of continuous rains.) Yields for the respective locations are presented in Tables 1, 2, and 3.

At Poplarville some of the plants were sprayed with dieldrin (before and after transplanting) to control cucumber beetles which are strongly suspected of transmitting gummy stem blight, a prominent fungus disease against which no resistant variety is now available. The melons from the transplants matured 10 to 14 days earlier. Their yield was about 60 percent greater in pounds per acre than that of the directly seeded crop. The dieldrin-sprayed transplants yielded a larger number of early maturing melons than the non-sprayed transplants. The transplants were grown in clay pots.

At Newton results were similar to those from Poplarville. The transplants produced an earlier crop. Their total yield was four times heavier than the one from the directly-seeded plots. At this location the relative yield differences were particularly great because of the fast-growing grass weeds which retarded the growth of the directly seeded crop to a much greater extent. However, yields in general vere light and the melons small. All transplants were grown in 4-inch paper ("Vita-Green") pots.

At Verona the transplants showed the greatest advantages. Here the dieldrin treated transplants (sprayed only once prior to being set in the field) yielded 189 melons per acre from the first two harvests, the non-treated transplants yielded 146 melons, while only 9 melons per acre

Table 1. Watermelon trial with transplants vs. direct seeding at South Mississippi Branch Experiment Station, Poplarville, Mississippi. 1958. Yield from five replicated test plots reported on per acre basis.

Materials used for planting	First harvest June 27		Second harvest July 10		Sum of two harvests	
	No. fruits harvested	Wt. in lbs.	No. fruits harvested	Wt. in lbs.	No. fruits harvested	Wt. in lbs.
Transplants, sprayed with Dieldrin	136	2827	285	4941	421	7768
Transplants, not sprayed	105	2101	335	6689	440	8790
Direct seeding	25	533	291	4904	316	5437

Table 2. Watermelon trial with transplants vs. direct seeding at Coastal Plain Branch Experiment Station, Newton, Mississippi. 1958. Yield from 5 replicated test plots reported on per-acre basis.

	Transplants		Direct seeding	
	No. melons	Total wt. lbs.	No. melons	Total wt. lbs.
First harvest	218	3314	11	153
Second harvest	87	1079	11	207
Third harvest	338	4338	153	1700
Total	643	8731	175	2060

Table 3. Watermelon trial with transplants vs. direct seeding at Northeast Branch Experiment Station, Verona, Mississippi. 1958. Yield from five replicated test plots reported on per-acre basis.

Treatment	First two harvests			All five harvests		
	No. melons	Ave. wt. (lbs.)	Total wt. (lbs.)	No. melons	Ave. wt. (lbs.)	Total wt. (lbs.)
Transplants treated with Dieldrin	189	34	6,410	937	26	24,355
Transplants not treated	146	34	4,962	842	28	23,495
Direct seeding	9	31	267	395	22	8,710

Table 4. Experiments with watermelon transplants vs. direct seeding. Summary of three replicated trials at three locations in 1958. Yields given on per-acre basis.

	First harvests			All harvests		
	No. melons	Ave .wt. (lbs.)	Total wt. (lbs.)	No. melons	Ave .wt. (lbs.)	Total wt. (lbs.)
All transplants	159	25	3923	657	22	14,628
Direct seeding	17	15	251	295	18	5,402

were harvested at the same time from the direct seeding. The total yield after five harvests from the transplants was rather large, about 24,000 pounds per acre, and the melons were of good size, averaging 27 to 34 pounds. The much lower total yield from the direct seeding, 8,710 pounds, was chiefly due to the abundance of weeds which also delayed further the maturity of the crop. Most melons, particularly from the first three harvests, were of the highest quality.

Pots used were mostly clay, but a few paper pots were also employed. The clay pots were removed, of course, while the paper pots were set in the ground and covered. Some retardation in growth was noticed in the paper pots because they did not disintegrate quickly enough. The Ferto-Pots disintegrated in the ground more quickly and for this reason they were used predominantly in later trials.

The summarized and averaged results of the 3 trials of 1958 are shown in Table 4. From this it may be confirmed that:

(1) By far the largest part of the early harvests came from the transplants.

(2) The melons from the transplants were larger, and

(3) The total weight of the crop from the transplants was nearly three times higher than from the direct seeding.

Trials in 1959

It was planned to repeat some of the outlying field experiments of the previous season with certain modifications, chiefly by incorporating anti-parasitic toxicants within the pots. Some injury was caused,

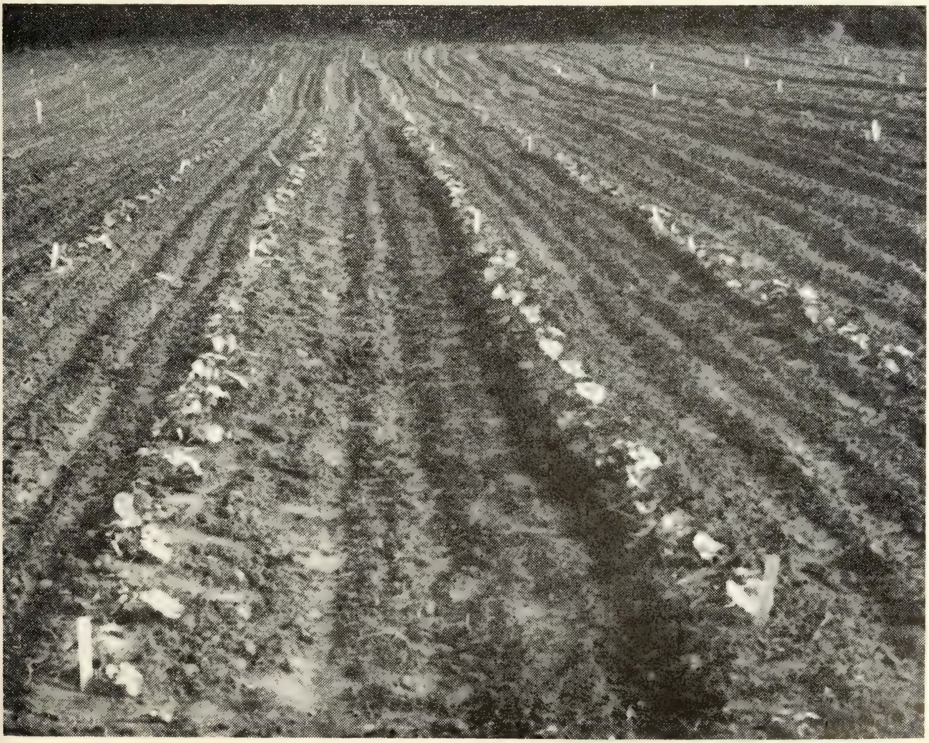

Figure 3. Cantaloupes after transplanting. The ground was sprayed with Alanap-3 a day before transplanting.

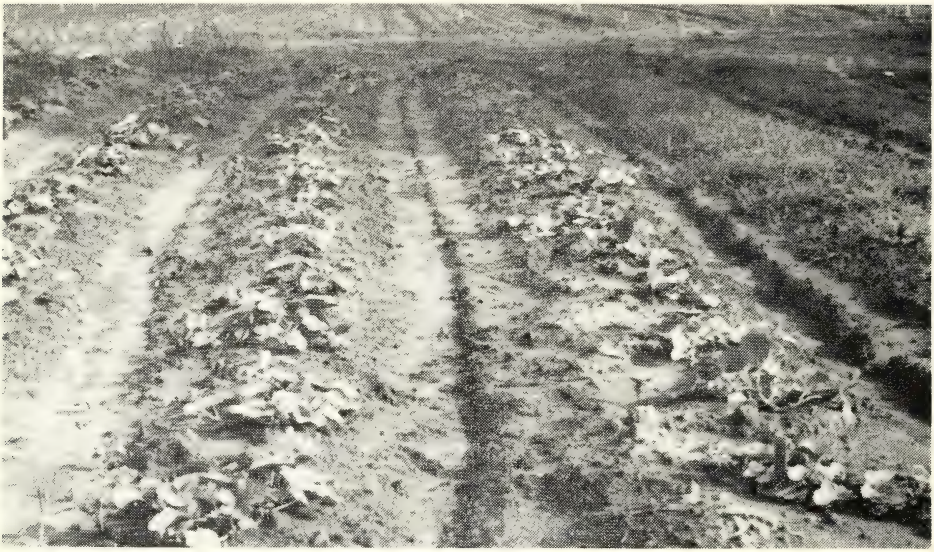

Figure 4. Rows in front and left with cantaloupe transplants, showing practically complete control of weeds following soil treatment with Alanap-3. Extreme right are check rows directly seeded and without the weed-killing chmical.

however, by an excess of certain of these experimental chemicals. These treatments will be modified and reported later. In addition, it was demonstrated that weather hazards and lack of precaution during transplanting may cause varying degrees of failure.

The transplanting trials, however, were continued at State College where an experiment was devised which combined chemical weed control with transplanting or direct seeding. It was conducted on several acres and included cantaloupes as well as watermelons.

All potted plants were raised in 3-inch "Ferto-Pots." The herbicide used was Alanap-3 at a rate of 4 lb./A of the concentrate (diluted with 40 gal. of water), which was sprayed on the ground a day or two before the transplants were set in the field.* This chemical has been demonstrated earlier by other workers to be particularly adaptable to cucurbit crops. The treatment gave a very good weed control. Most of the weeds were crabgrass (**Digiteria** spp.).

Results of this trial showed the benefits from combining transplanting with chemical weed control.

As a further step in the development of this project, consideration was given to the construction of a machine to transplant and water the potted plants at the same time. A preliminary model of such machine was made ready by Felix E. Edwards of the Department of Agricultural Engineering of this Station. Using this machine, a successful small-scale demonstration was made in 1959 in transplanting both watermelon and cantaloupe plants in experimental plots at State College.

Further work on all aims presented in this article is in progress.

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*The writers are indebted to Mr. Tildon Easley and Dr. Rupert D. Palmer of the Department of Plant Pathology and Physiology for supervising the application of the chemical in the field.

BULLETIN 589 JANUARY 1960

Mississippi Cotton Variety Tests for 1959

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Mississippi State University
AGRICULTURAL EXPERIMENT STATION

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HILL SECTION TESTS—G. D. Green, R. C. Albritton, R. E. Coats, S. P. Crockett, B. C. Hurt, B. E. Waggoner, and L. B. Walton

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Mississippi Cotton Variety Tests for 1960

IN THE DELTA

Five cotton variety trials were conducted by the Delta Branch Experiment Station during 1959 in the alluvial Yazoo-Mississippi Delta. One of these was on the Delta Station at Stoneville; the others were at outlying locations and conducted in cooperation with farmers and County Agents.

As a whole the 1959 season was excellent for cotton production in the Delta. The average yield is estimated as 617 pounds per acre, against 437 pounds in 1958 and 450 pounds in 1957. Plantation averages of 700 to 800 pounds of lint per acre are not uncommon. The quality of the 1959 Delta cotton is considered very good, with normal staple, high fiber strength, and medium micronaire.

Rain during the April 17-21 period, followed by cold weather and slow drying conditions delayed planting a few days, but the last week of April was ideal in most localities and the bulk of the Delta cotton acreage was planted during this period. July, August, and early September were generally favorable for setting bolls and fruiting continued later into September than usual, with resulting slowness of opening and later-than-usual beginning of harvest. The late crop of bolls on the upper part of the stalks and on the outer ends of the branches was the best in several years. Light infestations of boll weevil and excellent insect control were factors in the production of high yields. Killing frosts on November 7 and 8 had little effect on yields as most of the bolls had matured and opened naturally, except in late planted cotton. Climatic conditions were favorable during the fall and with few exceptions harvest was completed by early December.

The current strains of 14 commercial varieties which will be offered for sale for 1960 planting were used at the two test locations near Clarksdale. Twelve of these varieties were included in the Tunica test. At Yazoo City two additional varieties, Plains and DES 2331, were added, and to these were added California Acala 4-42 and Arizona Acala 44 at Stoneville. All seed came direct from the breeder-producers.

Table 1 gives results of the yield trial at the Delta Station. Conditions were excellent throughout the season and lint yields ranged from 1070 to 1300 pounds for 17 of the varieties, with an overall average of 1180 pounds of lint per acre. Acala varieties from the western part of the cotton belt are not generally adapted to the Delta and are low yielders in wet years. In dry years they yield better, but have heavy foliage and are slow producers. Many large bolls in the upper fruiting zones of the two Acala varieties were affected by boll rot and did not open. Acala 4-42 produced 23 percent less lint than the average of the 6 leading varieties, and Acala 44 produced 15 percent less. Acala varieties are not recommended for Delta planting.

The six varieties from which the largest amounts of cotton were harvested at the first picking on September 14 ranked first, fourth, fifth, thirteenth, fourteenth and sixteenth in total yield. Several of the slower producing varieties ranked high in total yield. This tendency was noticed also in the Yazoo City test. In the two Clarksdale tests, Rex and Auburn 56 were outstanding as early varieties at first picking and stood at the top in total yield.

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[1] Agronomist, CRD, ARS, USDA and Assistant Agronomist, Delta Branch Experiment Station, respectively. This report is based upon results from cooperative research conducted by the Mississippi Agricultural Experiment Station and Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture.

Table 2 gives results of the yield trial at Tunica.

The Tunica test was conducted on the Woolfolk Plantation about 6 miles northeast of Tunica. Uneven emergence resulting from shallow planting necessitated early spot planting with soaked seed. The total yields were considered reliable but no data is given for earliness as measured by the percent at first picking. Average lint yield of the 12 varieties was 948 pounds.

Table 3 gives results of the test conducted on the Williams Plantation north of Clarksdale on Highway 61. This test was on sandy loam soil planted to corn in 1957 and 1958 which had no known wilt history. Unfortunately, Fusarium wilt developed in several small areas within the test block and affected yields of several susceptible varieties to some extent. (See footnote, table 3). Cotton at this location developed normally and opened so rapidly that 77 percent of the 2834-pound seed cotton average was picked on September 9. The average lint yield was 1066 pounds.

Another yield trial was conducted near Clarksdale on the Heaton Plantation at the intersection of Highway 61 and 6. This study was planned for irrigation if needed, and received one irrigation by sprinklers on August 21. Maturity and boll opening were delayed somewhat so that 73 percent of the 2674-pound seed cotton yield was harvested on September 25. The average lint yield for this test was 980 pounds, as shown in Table 4.

The fourth outlying variety trial was conducted on the Shaeffer Plantation, 2 miles northwest of Yazoo City on the Yazoo River. Good production conditions were experienced but intermittent showers and low light intensity during September slowed maturity and caused some loss from boll rot. When the first picking was made October 1, 75 percent of the 3100-pound total yield was harvested. An unusually good top crop yielded the other 25 percent. Yields were exceptionally high, all varieties producing at the rate of better than 1000 pounds of lint per acre.

Tables 1 through 5 present the data on the five variety-yield trials. Pounds of seed cotton per acre harvested at first picking is reported in addition to total seed cotton and lint. Percent of the total harvested at first picking is also given as an estimate of earliness. Lint percentage, and fiber properties of staple length (classer and upper half mean), strength (T_1), and micronaire are given. Data on boll size are presented for the Stoneville test. The last column in each table gives the gross money value per acre of each variety for Strict Low Middling cotton. This value is computed by using the purchase price of Option A cotton, Strict Low Middling grade, for the staple length of the variety times the pounds of lint per acre, plus the seed at $40 per ton. Strict Low Middling is used as it best reflects the average grade obtained on many plantations. As the staple lengths of all varieties are in the 1 1/32+ to 1 3/32 inch range the relative values would be the same for either grade. Varieties are listed in each table in order of pounds of lint per acre. This order is closely followed by gross value per acre in most instances, the exceptions being varieties with lower lint percentages and more seed.

Table 6 shows the average lint percents, staple lengths, fiber strengths and micronaires for 14 varieties for all tests. Lint percents range from 35 for Delfos 9169 to 39 for Deltapine 15 and DES 1007. Classer's staple lengths averaged from 1 1/16— to 1 3/32 inches. Fibrograph lengths reflected wider differences, from 1.06 inches to 1.15 inches. Fiber strength or Tenacity (T_1) as determined by the Stelometer at 1/8 inch gauge is relative. By this measure Stardel, Fox 4, Deltapine 15 and D&PL Smooth Leaf have stronger fiber than the other varieties. Rex and Stoneville 3202 have the weak-

Table 1. Yield, lint percent, bolls per pound, earliness, staple length, strength, micronaire, and gross value per acre for the 1959 cotton variety test at Stoneville, Mississippi.

Stoneville	Yield per acre			Per-	Number bolls per pound		% at	Fiber properties				Total money
	Seed cotton			cent			first	Staple Length		Strength	Micro-	value per acre
Variety	First pick	Total	Lint	lint	Seed cotton	Lint	pick	Class	U.H.M.	T_1	naire	SLM
Stardel	2345	3548	1306	36.8	68	185	66	1 3/32	1.12	1.98	4.85	471
D&PL Smooth Leaf	2045	3262	1262	38.7	67	171	63	1 1/16	1.18	1.96	5.05	448
Stoneville 7	1760	3387	1260	37.2	65	175	52	1 1/16+	1.11	1.79	4.87	451
Stoneville 3202	2190	3396	1253	36.9	71	192	65	1 1/32+	1.05	1.68	4.63	444
Auburn 56	2330	3480	1239	35.6	69	194	67	1 1/32+	1.12	1.81	4.46	441
D&PL Fox 4	1980	3376	1222	36.2	65	180	59	1 1/16	1.15	2.00	5.26	438
DES 2331	1713	3190	1209	37.9	70	185	54	1 1/16+	1.09	1.74	4.25	432
Coker 100 A (WR)	2007	3380	1203	35.6	69	194	59	1 3/32+	1.18	1.84	4.59	438
Coker 124 B	1925	3376	1198	35.5	64	180	57	1 3/32	1.14	1.84	4.57	435
Delfos 9169	2034	3520	1193	33.9	58	171	58	1 3/32	1.17	1.82	4.15	436
Deltapine 15	1710	3104	1192	38.4	66	172	55	1 3/32	1.14	1.89	4.84	427
DES 1007	1690	3071	1161	37.8	73	193	55	1 1/16	1.06	1.81	4.55	413
Dixie King	2165	3202	1150	35.9	56	156	68	1 1/16+	1.14	1.80	4.65	414
Rex	2460	3134	1131	36.1	61	169	79	1 1/16	1.11	1.71	4.43	405
Plains	1822	3120	1108	35.5	64	180	58	1 1/16	1.07	1.85	4.38	398
Empire	2195	3150	1103	35.0	51	146	70	1 1/16	1.14	1.75	4.29	397
Acala 44	1400	2890	1069	37.0	57	154	48	1 3/32	1.12	2.01	4.40	385
Acala 4-42	1500	2595	968	37.3	54	145	58	1 1/16	1.14	2.07	4.48	345
Averages	1960	3230	1179	36.5			61		1.12	1.85	4.59	
LSD at 5%			117									

Planted April 29; harvested September 14 and November 9.

Table 2. Yield, lint percent, staple length, strength, micronaire, and gross value per acre for the 1959 cotton variety test at Tunica, Mississippi.

Tunica

Variety	Yield per acre		Percent lint	Fiber properties				Total money value per acre SLM
				Staple length		Strength	Micro-naire	
	Seed cotton	Lint		Class	U.H.M.	T_1		
	lbs.	lbs.	pct.	inch	inch	index	index	dollars
Stardel	2780	1050	37.8	1 1/16	1.14	1.74	4.65	374
Stoneville 7	2794	1048	37.5	1 1/32	1.10	1.62	4.75	370
D&PL Fox-4	2758	1000	36.3	1 1/16	1.15	1.49	4.75	358
Rex	2740	995	36.3	1 1/16	1.13	1.58	4.30	356
Coker 100 A (WR)	2737	988	36.1	1 1/16	1.14	1.73	4.30	354
DES 1007	2500	968	38.7	1 1/32	1.12	1.70	4.50	338
Stoneville 3202	2494	940	37.7	1 1/32	1.05	1.55	4.50	330
Coker 124 B	2557	918	35.9	1 1/16	1.17	1.69	4.40	329
Deltapine 15	2255	886	39.3	1 1/32	1.14	1.77	4.55	311
Dixie King	2330	875	37.6	1 1/32	1.16	1.68	4.50	307
D&PL Smooth Leaf	2230	854	38.3	1 1/16	1.18	1.87	4.35	303
Delfos 9169	2355	853	36.2	1 1/16	1.14	1.69	4.13	306
Averages	2543	948	37.3		1.14	1.68	4.47	
LSD at 5%		163						

Planted April 29; harvested October 12 and November 11.

Table 3. Yield, lint percent, earliness, staple length, strength, micronaire, and gross value per acre for the 1959 cotton variety test at Clarksdale, Mississippi.[1]

Clarksdale	Yield per acre					Fiber properties				Total money value per acre SLM
	Seed cotton					Staple length				
Variety	First pick	Total	Lint	Percent lint	% at first pick	Class	U.H.M.	Strength T_1	Micro-naire	
	lbs	lbs	lbs	pct	pct	inch	inch	index	index	dollars
Rex	2916	3310	1235	37.3	88	1 1/16	1.06	1.80	3.88	440
D&PL Fox 4	2360	3162	1183	37.4	75	1 1/16	1.11	1.87	4.95	422
Stoneville 7	2115	2960	1154	39.0	72	1 1/16	1.07	1.76	4.25	409
Auburn 56	2856	3165	1143	36.1	82	1 1/16	1.06	1.79	4.35	409
DES 1007	2180	2810	1110	39.5	78	1 1/16	1.03	1.68	4.25	393
Empire	2563	2995	1100	36.7	86	1 1/16	1.08	1.69	4.03	393
Coker 124 B	1967	2963	1076	36.3	66	1 1/16	1.12	1.93	4.60	385
Coker 100 A (WR)	2030	2837	1036	36.5	72	1 1/16	1.12	1.85	4.28	371
Dixie King	2187	2755	1028	37.3	79	1 1/16	1.10	1.74	4.33	367
Stardel	2100	2763	1025	37.1	76	1 1/16	1.09	1.88	4.10	366
D&PL Smooth Leaf	1787	2626	1003	38.2	68	1 1/16	1.13	1.99	4.40	356
Delfos 9169	2346	2833	990	34.9	83	1 3/32	1.10	1.78	3.98	360
Stoneville 3202	1980	2404	923	38.4	82	1 1/16	1.03	1.72	4.20	328
Deltapine 15	1704	2368	920	38.8	72	1 1/16	1.09	1.85	4.60	326
Averages	2200	2834	1066	37.4	77		1.09	1.81	4.30	
LSD at 5%			155							

Planted April 27; harvested September 9 and October 23.

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[1] Wilt areas developed in several small areas within the test block. Estimates of damage showed Deltapine 15, Stoneville 3202, Deltapine Smooth Leaf, DES 1007, Delfos 9169 and Stardel to be affected by wilt, apparently in the order named.

Table 4. Yield, lint percent, earliness, staple length, strength, micronaire, and gross value per acre for the 1959 irrigated cotton variety test at Clarksdale, Mississippi.

Clarksdale	Yield per acre					Fiber properties				Total money value per acre
	Seed cotton					Staple length				
Variety	First pick	Total	Lint	Percent lint	% at first pick	Class	U.H.M.	Strength T_1	Micro-naire	SLM
	lbs	lbs	lbs	pct	pct	inch	inch	index	index	dollars
Auburn 56	2310	3134	1110	35.4	74	1 1/16	1.12	1.77	4.48	403
Rex	2520	3052	1077	35.3	83	1 1/16	1.16	1.59	4.17	387
Stoneville 7	1933	2845	1060	37.3	68	1 1/16	1.10	1.63	4.68	378
Deltapine 15	1843	2677	1020	38.1	69	1 1/16	1.13	1.89	4.83	363
DES 1007	2000	2660	1020	38.4	75	1 1/32	1.15	1.75	4.62	360
Coker 124 B	1790	2700	1007	37.3	66	1 1/16	1.14	1.81	5.00	359
D&PL Fox-4	1944	2696	998	37.0	72	1 1/16	1.13	1.71	5.10	356
D&PL Smooth Leaf	1800	2550	990	38.8	71	1 1/16	1.10	1.80	5.13	351
Stoneville 3202	1900	2630	978	37.2	72	1 1/16	1.09	1.62	4.70	349
Dixie King	1933	2640	953	36.1	73	1 1/16	1.08	1.66	4.83	342
Delfos 9169	1854	2644	910	34.5	70	1 3/32	1.20	1.67	4.33	332
Stardel	1900	2440	910	37.3	78	1 1/16	1.17	1.97	4.68	325
Coker 100 A (WR)	1600	2383	858	36.0	67	1 3/32	1.14	1.79	5.08	311
Empire WR	1860	2383	830	34.8	78	1 1/16	1.09	1.72	4.40	299
Averages	1942	2674	980	36.7	73		1.13	1.74	4.72	
LSD at 5%			133							

Planted April 28; harvested September 25 and November 13.

Table 5. Yield, lint percent, earliness, staple length, strength, micronaire, and gross value per acre for the 1959 cotton variety test at Yazoo City, Mississippi.

Yazoo City	Yield per acre			Percent lint	% at first pick	Fiber properties				Total money value per acre SLM
	Seed cotton					Staple length		Strength T₁	Micro- naire	
Variety	First pick	Total	Lint			Class	U.H.M.			
	lbs	lbs	lbs	pct	pct	inch	inch	index	index	dollars
Stoneville 7	2255	3153	1230	39.0	72	1 1/16	1.12	1.43	4.45	436
Stoneville 3202	2510	3175	1222	38.5	79	1 1/16	1.09	1.64	4.50	434
Auburn 56	2670	3330	1209	36.3	80	1 1/16	1.10	1.58	4.30	433
Coker 100 A (WR)	2540	3220	1208	37.5	79	1 1/16	1.15	1.67	4.25	430
Coker 124 B	2372	3317	1207	36.4	72	1 1/16	1.17	1.67	4.45	432
D&PL Smooth Leaf	2023	3042	1202	39.5	67	1 1/16	1.16	1.79	4.70	425
Rex	2880	3273	1185	36.2	88	1 1/16	1.12	1.49	4.20	425
Stardel	2590	3178	1176	37.0	82	1 1/16	1.16	1.86	4.25	420
D&PL Fox-4	2230	3123	1165	37.3	71	1 1/16	1.12	1.84	4.85	415
DES 1007	2176	2974	1154	38.8	73	1 1/16	1.07	1.61	4.50	409
Dixie King	2280	3120	1145	36.7	73	1 1/16	1.13	1.70	4.50	409
Deltapine 15	2000	2890	1136	39.3	69	1 1/16	1.11	1.81	4.50	402
Delfos 9169	2377	3096	1105	35.7	77	1 3/32	1.13	1.63	4.28	401
DES 2331	1880	2940	1088	37.0	61	1 1/16	1.13	1.60	4.15	388
Plains	2160	2916	1085	37.2	74	1 1/16	1.10	1.61	4.35	387
Empire	2060	2843	1009	35.5	73	1 1/16	1.10	1.67	4.30	363
Averages	2312	3100	1158	37.4	75		1.12	1.66	4.41	
LSD at 5%			134							

Planted April 30; harvested October 1 and November 12.

est fiber. Fineness, as measured by the micronaire, ranged from 4.17 for Delfos 9169 and 4.20 for Rex to 4.90 for D&PL Fox 4. All varieties were in the medium (4.0 to 5.0) range of fineness.

Yield data were obtained from 4 replicated and randomized plots in each test. Other data were determined from two samples taken from the plots at first harvest. Classing was done by the Greenwood office of the Cotton Division, Agricultural Marketing Service, and the fiber properties data were determined by the fiber laboratory of the Crops Research Division, U. S. Department of Agriculture at Knoxville, Tennessee.

Table 6. Average lint percent, earliness, classer's staple length, upper half mean, fiber strength and micronaire of 14 varieties of cotton grown at five Delta locations in 1959.

Variety	Lint percent	Percent at first picking[1]	Classer's staple length	Upper half mean	Fiber strength T_1	Micronaire
	pct.	pct.	inches	inches	index	index
Coker 100 A (WR)	36.3	69	1 1/16+	1.15	1.78	4.50
Coker 124 B	36.3	65	1 1/16	1.15	1.79	4.60
Deltapine 15	38.8	66	1 1/16	1.12	1.84	4.66
D&PL Smooth Leaf	38.7	67	1 1/16	1.15	1.84	4.73
D&PL Fox-4	36.8	69	1 1/16	1.13	1.85	4.90
Delfos 9169	35.0	72	1 3/32	1.15	1.72	4.17
Dixie King	36.7	73	1 1/16	1.12	1.72	4.57
Empire[2]	35.5	77	1 1/16	1.10	1.71	4.26
Stoneville 3202	37.7	75	1 1/16-	1.06	1.64	4.50
Stoneville 7	38.0	66	1 1/16	1.10	1.69	4.60
Rex	36.2	84	1 1/16	1.12	1.63	4.20
Stardel	37.2	75	1 1/16	1.14	1.90	4.50
Auburn 56[2]	35.9	76	1 1/16	1.10	1.74	4.50
DES 1007	38.6	70	1 1/16-	1.09	1.71	4.48

[1] No earliness data for the Tunica test.

[2] For 4 tests; not in the Tunica test.

Cotton Tests in Hill Sections

Cotton yields were above average on most Experiment Station tests in the hill sections of Mississippi in 1959. Results published here show considerable shifting of position from year to year when varieties are ranked according to yield. This emphasizes the importance of studying the five-year average yields as well as last season's production in selecting a variety for planting.

This report covers the 1959 results of a year-by-year comparison of varieties of cotton adapted to the hill section of Mississippi, as well as average results for five or less years. The poorer varieties are usually dropped as new, promising ones become available. Tests were completed at six locations.

All tests included the same 16 varieties, planted in randomized blocks, single-row plots and six replications. Rows varied from 60 to 190 feet long and were 40 inches wide in most cases. The tests received close to the recommended amount and kind of fertilizer, were planted at about the usual time for the locality and had adequate grass and weed control. Insects were controlled by careful poisoning until boll weevil migration in early August after which control was not satisfactory even though poisoning was increased.

Seed of all varieties, except Empire, were supplied by the originators and were planted just as received. All had been machine delinted and treated. Seed of each variety in all tests came out of the same bag.

Samples of 100 well-developed bolls of each variety were picked from each of three replications in each test. These samples were ginned separately and the results averaged for lint percentage, staple length and boll size. The ginning and calculations were performed at State College.

Staple lengths are averages of the determinations of three professional cotton classers each representing a different organization and stapling samples from a different replication. Lint prices used in calculating acre values are averages of the Thursday quotations of the Memphis market for ten weeks beginning the last week in August. Seed were valued at $40 per ton.

The stand was too poor to harvest for record at Raymond. Some varieties were not a good stand at Verona and State College. At State College, there was considerable seedling disease which killed many plants and appeared to weaken others. The stand was satisfactory o good at the other locations. Corrections for skips were made for the excess over three feet per skip in the tests at State College and Verona.

Yields were higher than usual, ranging from a high of 1254 pounds of lint per acre for the highest yielding variety at the Northeast Branch Station at Verona to a low of 498 pounds for the lowest yielding variety at the Coastal Plains Branch Station at Newton. The bolls were larger and the staple longer than average. The lint percentage was not far from average.

The season varied considerably from station to station. The crop suffered from drought at State College and excessive moisture at Newton. Most of the other stations had some periods of both too wet and too dry weather.

There were rather large differences

between the higher yielding and lower yielding varieties at all stations. These differences were found to be highly significant when analyzed statistically except for the test at Newton in which they were not significant.

There was considerable shifting in the ranking of the different varieties compared to past years. This is one reason average results covering several years are more reliable guides when selecting a variety than only one year's results. Also, the highest yielding variety was not usually the same at any two locations. This indicates the advisability of studying closely the results from the station which has soil and other conditions most nearly like one's own.

Explanation of Tables

Yield and other data for 1959 and averages for five or fewer years are shown in the accompanying tables. Fertilizer used, soil type, planting dates and number of poison applications are shown in footnotes below the tables. The term "LSD" means the least difference between varieties that is considered a real difference with odds of 19 to 1. The term "CV" means coefficient of variation and the lower it is, the better the test. The value per acre in the averages tables is based on Middling cotton. The staple in all tables is expressed in 32nds. inches. A staple of 33 for instance is 1 1/32 inches long and one of 34 is 1 2/32 or 1 1/16, etc.

A blank space in the averages tables means that that variety was not tested that year or the full number of years. For three varieties, the averages in the lint percent, staple and bolls per pound lint columns are only for the years the variety was in the test and cannot be compared with these figures for the varieties which were in the test the full number of years.

Deltapine SL means Deltapine Smooth Leaf, DES 1007 is Delta Station Smooth Leaf of which seed are not available commercially.

Leading Varieties

The highest yielding varieties for five or less years as shown in the averages tables for the respective locations are, in order of yield:

North Mississippi Branch Station, Holly Springs: Stoneville 3202, Auburn 56, Dixie King and Plains. Stoneville 7 and Pope have done well for the four years they have been in the tests and Fox 4 performed well in 1959.

Pontotoc Ridge Soil, Pontotoc Ridge-Flatwoods Branch Station: Dixie King, Auburn 56, Plains and Stoneville 3202. Pope has done well the four years it has been in the test, Rex for two years and Coker 100A, WR led in 1959. On Flatwood Soil at the same station for the four years 1954, 55, 56 and 59, Auburn 56, Plains, Empire and Delfos 9169. Dixie King did well the three years it was in the test.

Coastal Plains Branch Station, Newton: Dixie King, Auburn 56, Stoneville 3202 and Plains.

Brown Loam Branch Station, Raymond: Auburn 56 was well ahead followed by Empire during 1955-57. This test was not reported in 1958 or 1959 due to poor stands.

Central Station, State College: Empire, Dixie King and Auburn 56. In 1959, Stoneville 7 led followed by Delfos 9169 and Coker 100A, WR.

Cotton variety testing was resumed at the following stations in 1959 after a lapse of several years. The leading varieties for 1959 are:

Northeast Mississippi Branch Station, Verona: Stoneville 3202 followed by Stoneville 7, Auburn 56, Dixie King and Coker 100A, WR.

Black Belt Branch Station, Brooksville: Plains, Stoneville 3202, Dixie King, Stonevile 7 and Auburn 56.

The following varieties are resistant

or tolerant to Fusarium Wilt and one of them should be planted on soils with an appreciable amount of disease: Auburn 56, Coker 100A, WR, Empire, Dixie King and Rex.

Originators of Varieties in Tests

Auburn 56 and Plains — Alabama Agri. Experiment Station, Auburn, Alabama.

Coker 100A, WR and Coker 124 — Coker Pedigreed Seed Co., Hartsville, S.

State College

Cotton Variety Averages, Central Station, State College.

Variety	Yield per acre, pound lint 1955	1956	1957	1958	1959	Average	Averages Dollar val. per acre midd.	Lint %	Staple 32nds. inch	Bolls per lb. lint
Empire	716.3	666.5	604.0	358.0	734.6	615.9	241.57	36.1	34	158
Dixie King	621.2	600.7	582.2	403.5	688.2	579.2	227.17	36.9	34	156
Auburn 56	533.5	661.3	536.7	399.4	700.4	566.3	224.70	35.1	34	192
Plains	466.1	644.1	536.5	408.7	702.1	551.5	213.46	36.7	33	170
Delfos 9169	572.0	564.7	488.2	352.2	777.5	550.9	220.86	35.4	35	174
Stoneville 3202	504.6	594.9	543.6	405.4	684.5	546.6	208.84	38.2	33	188
Deltapine 15	511.5	553.4	520.3	411.6	612.5	521.9	202.89	39.0	34	184
Stoneville 7	....	658.1	522.1	348.5	798.6	....	....	38.0	34	188
Stardel	....	648.2	551.1	330.6	695.7	....	....	37.1	34	199
Pope	....	664.1	545.2	465.1	605.4	....	....	39.1	33	174
Coker 124	....	613.8	492.4	332.2	670.2	....	....	36.5	34	178
Deltapine SL	....	....	607.7	440.6	634.8	....	....	38.9	34	186
Rex	....	....	....	430.1	716.8	....	....	36.4	34	169
Coker 100A, WR	....	....	....	....	755.0	....	....	36.8	36	178
DES 1007	....	....	....	....	727.0	....	....	39.5	34	177
Fox 4	....	....	....	....	634.4	....	....	37.2	35	180

Cotton Varieties, Central Station, State College, 1959.

Variety	Yield per acre lbs. lint	Total acre values, dollars Middling	St. low Middling	Low Middling	Lint percent	Staple 32nds. in.	Bolls per lb. lint
Stoneville 7	798.6	298.66	279.30	252.10	38.0	35.3	181.7
Delfos 9169	777.5	303.13	281.90	252.36	35.7	37.3	165.7
Coker 100A, WR	755.0	288.37	268.36	241.52	36.8	36.0	177.5
Empire	734.6	275.88	258.06	233.05	36.9	35.3	142.1
DES 1007	727.0	266.80	249.89	226.23	39.5	34.3	176.7
Rex	716.8	268.37	250.99	226.58	37.7	35.3	160.2
Plains	702.1	264.30	247.28	223.37	36.3	35.7	161.5
Auburn 56	700.4	269.70	251.14	226.24	34.8	36.0	192.9
Stardel	695.7	265.73	247.29	222.56	36.8	36.0	194.7
Dixie King	688.2	258.36	241.67	218.24	37.0	35.7	149.8
Stoneville 3202	684.5	255.98	239.38	216.08	38.0	35.3	187.9
Coker 124	670.2	257.10	239.34	215.52	35.7	36.0	180.8
Deltapine SL	634.8	237.40	222.01	200.39	38.0	35.7	185.3
Fox 4	634.4	237.97	222.59	200.99	37.2	35.3	180.4
Deltapine 15	612.5	227.84	212.98	192.13	39.5	35.0	174.7
Pope	605.4	225.99	211.31	190.70	38.5	35.0	171.4
LSD at 5%	78.8	....	....	....	....	....	....
CV	9.9%	....	....	....	....	....	....

Soil: Verona fine sandy loam. Planted April 27
Fertilizer: 400 lbs. 9-12-12 under, 36 lbs. N around. Poisoned 13 times.

C. and Tunicia, Mississippi.

Delfos 9169, Stoneville 7 and Stoneville 3202 — Stoneville, Pedigreed Seed Co.. Stoneville, Mississippi.

Deltapine 15, Deltapine Smooth Leaf and Fox 4 — Delta and Pine Land Co., Scott, Mississippi.

DES 1007 — Delta Branch Experiment Station, Stoneville, Mississippi.

Dixie King — Bodshaw Seed Co., Indianola, Mississippi.

Holly Springs

Cotton Variety Averages, North Mississippi Branch Station, Holly Springs

	Yield per acre, pounds lint						Averages			
Variety	1955	1956	1957	1958	1959	Average	Dollar val. per acre midd.	Lint %	Staple 32nds. inch	Bolls per lb. lint
Stoneville 3202	488.7	356.3	708.6	897.3	857.8	661.7	245.35	39.4	32	209
Auburn 56	450.7	384.3	706.6	828.3	853.4	644.7	248.89	37.0	33	201
Dixie King	517.7	426.7	737.9	761.3	778.7	644.5	248.70	38.3	33	169
Plains	450.7	390.4	680.4	811.2	780.6	622.7	237.97	38.0	33	193
Delfos 9169	521.9	368.7	700.7	743.3	706.5	608.2	238.86	36.9	34	194
Empire	487.6	392.9	719.9	727.3	699.4	605.4	234.55	38.1	33	175
Deltapine 15	493.6	332.7	632.4	831.4	716.6	601.3	228.20	40.4	33	199
Pope		401.9	743.7	892.1	892.3			41.6	31	198
Stoneville 7		427.1	693.6	948.1	831.4			40.9	32	191
Stardel		373.4	757.7	855.7	711.5			39.8	33	218
Coker 124		368.2	683.1	795.1	776.6			38.8	34	201
Deltapine SL			715.3	849.3	771.3			41.2	33	189
Rex				657.5	756.1			39.3	33	172
Fox 4					831.0			39.9	34	174
DES 1007					826.5			42.7	33	181
Coker 100A, WR					783.9			40.1	34	173

Cotton Varieties, North Mississippi Branch Station, Holly Springs, 1959.

	Yield	Total acre values, dollars					
Variety	per acre lbs. lint	Middling	St. low Middling	Low Middling	Lint percent	Staple 32nds. in.	Bolls per lb. lint
Pope	892.3	316.61	295.42	267.26	41.7	33.3	177.9
Stoneville 3202	857.8	305.47	285.10	258.04	40.6	33.3	190.6
Auburn 56	853.4	314.08	294.24	266.46	38.7	34.3	174.5
Stoneville 7	831.4	304.07	284.74	257.68	40.5	34.3	175.1
Fox 4	831.0	304.60	285.22	258.17	39.9	34.3	173.8
DES 1007	826.5	292.32	272.69	246.62	42.7	33.0	181.4
Coker 100A, WR	783.9	287.08	268.86	243.34	40.1	34.7	172.5
Plains	780.6	286.36	268.22	242.81	39.6	34.7	173.8
Dixie King	778.7	286.27	267.77	242.42	39.4	34.3	145.9
Coker 124	776.6	288.98	270.15	243.71	39.4	35.0	171.8
Deltapine SL	771.3	281.08	263.14	238.04	41.6	34.7	171.8
Rex	756.1	276.43	258.85	234.24	40.6	34.3	160.3
Deltapine 15	716.6	261.65	244.99	221.66	41.0	34.7	168.0
Stardel	711.5	260.74	244.20	221.04	39.9	34.0	181.4
Delfos 9169	706.5	263.73	246.60	222.54	38.5	35.3	167.4
Empire	699 4	257.03	240.77	218.01	39.1	34.0	152.7
LSD at 5%	84.1						
CV	9.3%						

Soil: Grenada Silt Loam. Planted May 5.

Fertilizer: 600 lbs. 6-8-8 under plus 36 lbs. N around. Poisoned 15 times.

Empire — Georgia Experiment Station, Experiment, Georgia.

Pope — Tennessee Agri. Exp. Station, Knoxville, Tenn.

Rex — Cotton Branch Experiment Station, Marianna, Arkansas.

Stardel — Louisiana Agri. Experiment Station, Baton Rouge, Louisiana.

Newton

Cotton Variety Averages, Coastal Plain Branch Station, Newton.

	Yield per acre, pounds lint						Averages			
Variety	1955	1956	1957	1958	1959	Average	Dollar val. per acre midd.	Lint %	Staple 32nds. inch	Bolls per lb. lint
Dixie King	509.0	400.1	486.6	219.9	588.8	440.9	168.40	37.8	33	169
Auburn 56	416.6	383.1	508.4	270.1	623.5	440.3	170.39	36.4	33	210
Stoneville 3202	505.8	325.3	485.4	211.6	585.0	422.6	158.96	38.7	32	220
Plains	498.5	343.2	475.7	246.3	540.7	420.9	160.86	37.1	33	198
Empire	406.2	382.0	495.9	221.5	498.3	400.8	152.02	37.9	33	171
Delfos 9169	440.7	334.1	404.9	127.5	528.2	367.1	144.03	36.4	34	203
Deltapine 15	406.5	245.5	401.5	165.4	521.1	348.0	133.02	38.6	33	223
Pope	-------	397.3	540.0	250.3	537.4	-------	-------	40.0	32	202
Stoneville 7	-------	388.6	461.5	180.5	590.0	-------	-------	38.6	33	214
Coker 124	-------	325.0	455.0	198.8	572.4	-------	-------	36.9	34	203
Stardel	-------	310.1	440.5	189.7	571.2	-------	-------	37.7	34	230
Deltapine SL	-------	-------	398.3	204.1	586.4	-------	-------	38.8	34	203
Rex	-------	-------	-------	295.3	588.8	-------	-------	36.9	34	167
DES 1007	-------	-------	-------	-------	573.6	-------	-------	40.2	35	185
Coker 100A, WR	-------	-------	-------	-------	565.7	-------	-------	38.3	35	183
Fox 4	-------	-------	-------	-------	542.9	-------	-------	37.2	35	188

Cotton Varieties, Coastal Plain Branch Station, Newton, 1959.

Variety	Yield per acre lbs. lint	Total acre values, dollars Middling	St. low Middling	Low Middling	Lint percent	Staple 32nds. in.	Bolls per lb. lint
Auburn 56	623.5	234.16	219.04	197.81	36.9	35.0	184.4
Stoneville 7	590.0	220.09	205.78	185.69	38.7	35.0	190.4
Rex	588.8	220.21	205.93	185.88	38.0	35.0	161.5
Dixie King	588.8	217.26	203.57	184.41	38.0	34.7	152.6
Deltapine SL	586.4	218.28	204.06	184.10	39.3	35.0	198.4
Stoneville 3202	585.0	215.45	201.85	182 81	38.5	34.0	197.7
DES 1007	573.6	212.87	198.96	179.43	40.2	35.0	185.2
Coker 124	572.4	214.88	201.00	181.51	37.0	35.7	182.2
Stardel	571.2	213.70	199.85	180.40	37.9	35.7	194.1
Coker 100A, WR	565.7	211.33	197.61	178.35	38.3	35.7	182.5
Fox 4	542.9	203.65	190.48	172.00	37.2	35.3	187.5
Plains	540.7	202.60	189.49	171.08	37.5	35.3	176.9
Pope	537.4	196.94	184.45	166.96	39.9	34.0	186.4
Delfos 9169	528.2	201.98	187.99	169.21	36.5	36.3	180.6
Deltapine 15	521.1	191.43	179.32	162.35	39.2	34.3	188.4
Empire	498.3	187.06	174.98	158.01	37.0	35.3	156.0
LSD at 5%	Difference not significant						
CV	12.6%	-------	-------	-------	-------	-------	-------

Soil: Stough Loam. Planted April 30.

Fertilizer: 72 lbs. N, 72 lbs. P_2O_5, 72 lbs. K_2O per acre. Poisoned 10 times.

Pontotoc Ridge

Cotton Variety Averages, Pontotoc Ridge, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc.

Variety	Yield per acre, pounds lint						Averages			
	1955	1956	1957	1958	1959	Average	Dollar val. per acre midd.	Lint %	Staple 32nds. inch	Bolls per lb. lint
Dixie King	601.5	330.0	614.6	707.0	892.3	629.1	244.83	37.1	34	155
Auburn 56	609.0	379.6	550.1	716.8	877.6	626.6	245.23	36.1	34	194
Plains	639.5	355.2	530.7	749.3	743.4	603.6	235.42	36.8	33	180
Stoneville 3202	636.0	276.8	551.5	737.3	798.0	599.9	228.16	38.4	33	192
Empire	619.1	287.5	543.2	656.8	706.7	562.7	219.67	37.0	34	155
Delfos 9169	575.6	270.0	434.6	580.7	737.6	519.7	206.38	35.7	34	185
Deltapine 15	484.8	292.2	481.9	606.7	643.6	501.8	192.95	38.4	33	196
Pope	-------	401.2	546.5	734.4	854.3	-------	-------	39.7	33	176
Coker 124	-------	271.0	484.1	646.8	793.5	-------	-------	37.0	34	181
Stardel	-------	258.3	516.1	707.7	724.2	-------	-------	38.1	34	199
Stoneville 7	-------	309.7	486.2	675.7	662.0	-------	-------	38.4	34	194
Deltapine SL	-------	-------	473.9	737.2	745.6	-------	-------	39.8	34	178
Rex	-------	-------	-------	763.0	931.1	-------	-------	38.3	35	149
Coker 100A, WR	-------	-------	-------	-------	945.9	-------	-------	37.6	36	169
DES 1007	-------	-------	-------	-------	882.1	-------	-------	39.9	34	176
Fox 4	-------	-------	-------	-------	751.4	-------	-------	37.5	34	171

Cotton Varieties, Pontotoc Ridge Soil, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, 1959.

Variety	Yield per acre lbs. lint	Total acre values, dollars			Lint percent	Staple 32nds. in.	Bolls pe lb. lint
		Middling	St. low Middling	Low Middling			
Coker 100A, WR	945.9	360.18	335.12	301.49	37.6	36.3	169.3
Rex	931.1	354.69	330.02	296.92	37.5	36.0	151.7
Dixie King	892.3	329.62	308.87	279.82	37.7	34.7	136.2
DES 1007	882.1	323.26	302.76	274.04	39.9	34.3	175.8
Auburn 56	877.6	330.37	309.09	279.20	36.3	35.0	167.4
Pope	854.3	312.65	292.79	264.98	40.3	34.3	155.9
Stoneville 3202	798.0	294.12	275.56	249.59	38.3	34.3	171.8
Coker 124	793.5	298.11	278.87	251.85	36.8	35.7	170.5
Fox 4	751.4	277.78	260.31	235.85	37.5	34.3	171.2
Deltapine SL	745.6	277.64	259.56	234.17	39.2	35.7	173.8
Plains	743.4	279.40	261.37	236.06	36.7	35.0	160.3
Delfos 9169	737.6	282.73	263.18	236.96	35.9	36.0	160.3
Stardel	724.2	270.84	253.27	228.61	38.0	35.3	184.4
Empire	706.7	265.50	248.36	224.30	36.8	35.7	133.8
Stoneville 7	662.0	246.85	230.80	208.26	38.8	35.3	174.5
Deltapine 15	643.6	239.49	223.89	201.97	39.4	35.0	166.2
LSD at 5%	119.8	-------	-------	-------	-------	-------	-------
CV	13.1%	-------	-------	-------	-------	-------	-------

Soil: Atwood Silty Clay Loam.

Fertilizer: 600 lbs. 5-10-5 under plus 156 lbs ammonium nitrate around.

Planted April 25.

Poisoned 5 times.

Flatwoods

Cotton variety averages, Flatwoods, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc.

Variety	Yield per acre, pounds lint					Averages			
	1954	1955	1956	1959	Average	Dollar val. per acre midd.	Lint %	Staple 32nds. inch	Bolls per lb. lint
Auburn 56	208.3	522.6	348.5	733.5	453.2	170.01	37.0	32	229
Plains	190.6	530.0	350.3	732.3	450.8	166.92	38.1	31	210
Empire	190.4	555.9	326.9	719.8	448.2	165.84	39.0	31	181
Delfos 9169	169.9	511.6	323.2	659.0	415.9	156.93	37.3	32	207
Deltapine 15	142.3	507.0	324.2	584.9	389.6	140.83	40.1	30	235
Dixie King	-------	564.9	340.3	734.7	-------	-------	38.6	32	168
Stoneville 3202	-------	512.2	332.3	694.4	-------	-------	40.4	31	205
Pope	-------	-------	304.7	719.8	-------	-------	40.2	32	203
Stoneville 7	-------	-------	318.8	707.1	-------	-------	40.1	32	217
Coker 124	-------	-------	313.6	679.2	-------	-------	38.6	33	201
Stardel	-------	-------	296.1	663.9	-------	-------	38.4	33	224
DES 1007	-------	-------	-------	746.5	-------	-------	42.4	32	176
Rex	-------	-------	-------	709.9	-------	-------	41.0	34	163
Coker 100A, WR	-------	-------	-------	686.2	-------	-------	39.3	34	181
Deltapine SL	-------	-------	-------	682.7	-------	-------	41.7	33	181
Fox 4	-------	-------	-------	660.5	-------	-------	39.9	34	185

Cotton Varieties, Flatwood Soil, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, 1959.

Variety	Yield per acre lbs. lint	Total acre values, dollars			Lint percent	Staple 32nds. in.	Bolls per lb. lint
		Middling	St. low Middling	Low Middling			
DES 1007	746.5	257.74	240.01	214.63	42.4	32.7	175.8
Dixie King	734.7	270.40	253.31	229.40	38.7	34.3	148.7
Auburn 56	733.5	270.95	253.90	230.02	37.7	34.0	181.4
Plains	732.3	269.71	252.68	228.85	38.5	34.7	172.5
Empire	719.8	263.79	247.06	223.63	39.9	34.0	134.6
Pope	719.8	255.73	238.63	215.92	41.3	33.3	177.2
Rex	709.9	259.20	242.70	219.59	41.0	34.3	162.6
Stoneville 7	707.1	251.90	235.10	212.79	40.5	33.7	185.9
Stoneville 3202	694.4	247.19	230.70	208.79	40.7	33.3	190.6
Coker 100A, WR	686.2	252.00	236.05	213.71	39.3	34.3	181.4
Deltapine SL	682.7	242.23	226.02	204.48	41.7	33.3	180.7
Coker 124	679.2	253.54	237.07	213.95	38.5	35.0	184.4
Stardel	663.9	243.64	228.21	206.60	39.5	34.3	185.9
Fox 4	660.5	242.06	226.70	205.20	39.9	34.0	185.1
Delfos 9169	659.0	243.25	227.93	206.48	37.9	34.3	171.8
Deltapine 15	584.9	213.56	199.96	180.92	41.0	34.0	185.1
LSD at 5%	81.7	-------	-------	-------	-------	-------	-------
CV	10.2%	-------	-------	-------	-------	-------	-------

Soil: Falkner Fine Sandy Loam.
Fertilizer: 500 lbs. 5-10-5 per acre.

Planted May 12.
Poisoned 7 times.

Cotton Varieties, Northeast Mississippi Branch Station, Verona, 1959.

Verona Variety	Yield per acre lbs. lint	Total acre values, dollars Middling	 St. low Middling	 Low Middling	Lint percent	Staple 32nds. in.	Bolls per lb. lint
Stoneville 3202	1254.6	460.25	431.09	390.25	39.6	34.3	178.7
Stoneville 7	1199.5	446.50	417.41	376.57	39.3	35.3	186.5
Auburn 56	1164.0	435.96	407.73	368.10	37.6	35.0	172.1
Dixie King	1162.0	433.93	405.75	366.18	38.4	35.0	138.2
Coker 100A WR	1155.6	431.69	403.67	364.32	38.3	35.3	172.7
DES 1007	1155.6	409.89	382.44	345.98	41.8	33.7	178.5
Delfos 9169	1128.7	429.65	399.74	359.61	37.7	36.3	164.1
Pope	1110.9	396.29	369.90	334.85	40.1	33.7	169.2
Deltapine SL	1059.5	392.28	366.59	330.51	40.9	35.0	174.6
Coker 124	1055.5	394.88	369.29	333.35	37.9	35.7	175.0
Stardel	1049.2	391.52	366.08	330.36	38.6	35.0	187.5
Fox 4	1037.4	386.57	361.41	326.09	39.0	35.0	168.5
Deltapine 15	1036.5	384.02	358.88	323.59	40.7	35.0	178.7
Empire	1032.4	386.53	361.49	326.34	37.7	35.3	145.8
Plains	1032.4	386.24	361.20	326.05	37.9	35.7	155.2
Rex	933.7	347.32	324.68	292.88	39.5	35.7	159.3
LSD at 5%	145.1						
CV	11.5%						

Soil: Iuka Silt Loam.
Fertilizer: 67 lbs. N, 98 lbs. P_2O_5, 60 lbs. K_2O per acre.
Planted May 5.
Poisoned 8 times.

Cotton Varieties, Black Belt Branch Station, Brooksville, 1959.

Brooksville Variety	Yield per acre lbs. lint	Total acre values, dollars Middling	 St. low Middling	 Low Middling	Lint percent	Staple 32nds. in.	Bolls per lb. lint
Plains	854.3	321.35	300.63	271.54	36.5	35.7	189.0
Stoneville 3202	844.6	310.83	291.19	263.70	38.7	34.0	209.0
Dixie King	835.6	318.54	297.40	266.70	37.3	36.0	161.4
Stoneville 7	826.7	308.71	288.67	260.52	38.4	35.3	204.3
Auburn 56	816.7	307.07	287.27	259.46	36.6	35.0	206.2
Coker 124	808.4	308.06	286.64	257.90	37.4	36.0	207.1
DES 1007	798.9	296.37	277.00	249.80	40.3	35.3	210.0
Empire	794.9	298.41	279.13	252.07	37.0	35.3	164.3
Rex	783.9	292.62	273.61	246.92	38.5	35.7	177.2
Deltapine SL	777.9	294.32	273.61	245.96	39.5	36.0	205.2
Stardel	774.2	294.70	274.19	246.66	37.7	36.0	214.0
Deltapine 15	749.6	278.75	260.57	235.04	39.6	35.7	201.6
Fox 4	728.0	273.50	255.85	231.06	36.8	35.3	217.0
Coker 100A, WR	717.1	268.58	251.19	226.78	37.6	35.7	198.9
Pope	705.3	259.48	243.08	220.12	38.8	34.7	201.6
Delfos 9169	693.5	271.15	252.22	225.87	35.0	37.0	200.7
LSD at 5%	81.0						
CV	9.1%						

Soil: Houston clay.
Fertilizer: 80 lbs. N, 60 lbs. P_2O_5, 50 lbs. K_2O per acre.
Planted April 7.
Poisoned 8 times.

Raymond

Cotton variety averages, Brown Loam Branch Station, Raymond.

	Yield per acre, pounds lint				Average			
Variety	1955	1956	1957	Average	Dollar val. per acre midd.	% Lint	Staple 32nds. inch	Bolls per lb. lint
Auburn 56	758.8	496.9	983.1	746.3	298.00	35.2	34	208
Empire	702.3	549.7	864.5	705.5	276.04	37.4	33	158
HiBred	710.5	554.8	739.7	668.3	232.80	40.3	29	152
Dixie King	713.8	552.0	734.8	666.9	260.30	37.0	33	160
Plains	781.0	502.0	694.0	659.0	256.03	36.8	33	194
Deltapine 15	815.8	402.6	735.0	651.1	255.10	38.6	33	204
Coker Wilt	715.3	474.5	753.9	647.9	259.60	35.6	34	203
Fox	773.2	400.6	756.4	643.4	252.04	36.7	33	221
Stoneville 3202	736.2	461.0	728.6	641.9	239.45	38.4	31	209
Delfos 9169	745.4	414.5	599.2	586.4	237.47	36.1	35	194
Pope	-------	500.8	836.2	-------	-------	40.0	32	208
Coker 124	-------	461.0	812.9	-------	-------	37.4	33	202
DES 1000	-------	497.5	744.5	-------	-------	41.6	32	188
Stoneville 7	-------	442.5	741.4	-------	-------	38.7	32	210
Stardel	-------	362.5	811.9	-------	-------	38.6	33	235
Deltapine SL	-------	-------	869.4	-------	-------	38.6	35	189

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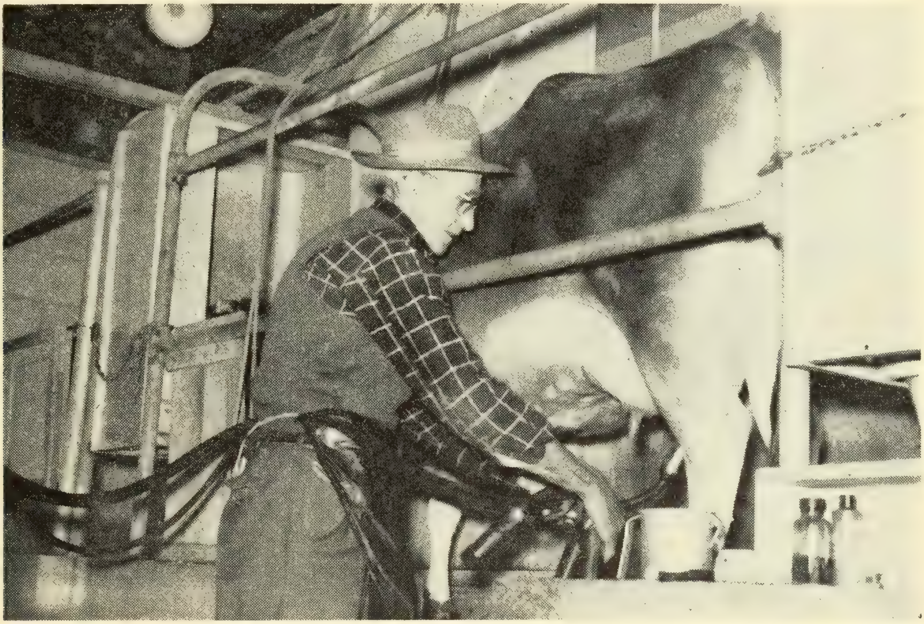
BULLETIN 590 FEBRUARY 1960

Producing Milk for Manufacturing



A Study of Management and Returns to Labor and Capital, Pontotoc Branch Experiment Station

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

PRODUCING MILK FOR MANUFACTURING

A Study of Management and Returns to Labor and Capital, Pontotoc Branch Experiment Station

By B. C. HURT, JR., E. N. GRAHAM
And J. G. HAMILL

Studies in management and breeding were initiated in 1955 at the Pontotoc Branch Experiment Station to determine the monetary returns from grade Jerseys and Holsteins based on prices obtained from manufactured milk.

The Jerseys were purchased locally and the Holsteins were bought from dairies in Wisconsin. Breeding has been done by artificial insemination, in cooperation with the area Artificial Breeders Association. During the winter of 1955-56, 15 Jerseys and 13 Holsteins were in production for the first time. Since then, most of the heifer calves have been kept to build up the herd so that intensive culling can be done. By 1959, the herd had increased to 85 female animals, which include 42 two-year-old heifers and mature cows.

Facilities

The cows are milked by one man in a parlor-type barn. Two elevated stalls on each side of the center aisle facilitate easy handling. A two-unit machine is used with 4 cows in the parlor at one time. Each cow's milk is recorded at each milking. The milk is conducted through a glass pipeline to the cans in the adjoining milkroom. A covered concrete pen is connected to the milk parlor to hold the cows prior to milking.

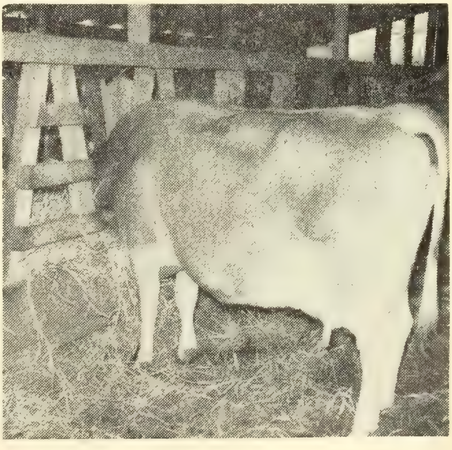
Two pole type sheds are used for feeding hay and silage. Silage is stored in a 150-ton capacity concrete trench silo.

Pasture Program

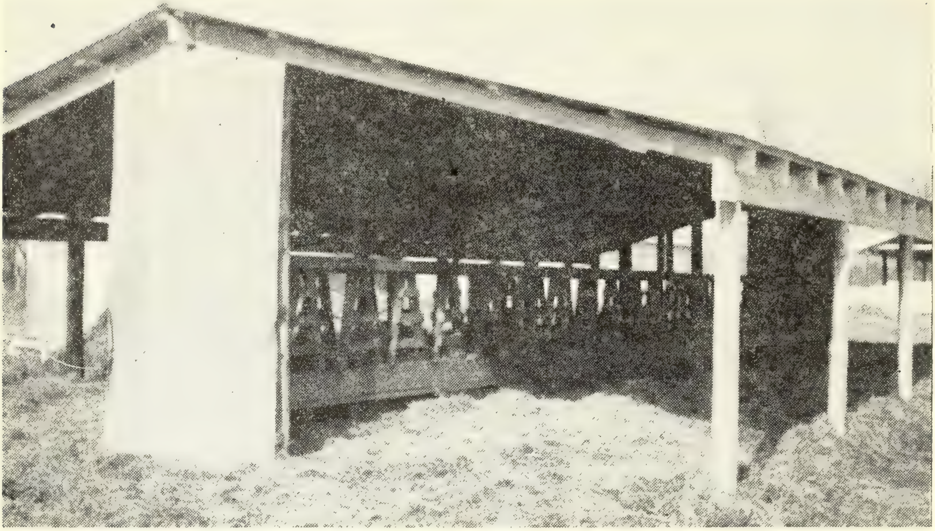
The permanent and temporary pastures consist of approximately 70 acres located in the flatwoods soil area. Pasture practices described here conform to current recommendations.

Permanent pastures, composed of Dallis grass and white clover, are utilized from late winter through the summer months. Two tons of lime are applied to these pastures at five-year intervals. An annual application of 60 pounds available phosphorous and 60 pounds available potash is applied. Under ideal growing conditions these pastures provide enough grazing for two cows per acre. However, through much of the summer an acre will provide grazing for only one cow during dry periods, even with one cow per acre, supplementary grazing is necessary.

One half acre of Starr millet per cow is planted during the first half of May to provide grazing during this time. The seeding rate for millet is 20 pounds per acre. Thirty-three pounds of available nitrogen and 40 pounds of available phosphorous are applied at planting time.



Hay has a vital role in the production of milk for manufacture.



Pole sheds used for feeding hay.

An annual application of potash is made at the time oats are planted on this same area. When needed, 33 pounds of available nitrogen is applied as a top dressing. Millet usually provides grazing by the last of June and is control grazed for a few hours each day until late August when the land is prepared for oat planting. If additional land is available, millet planting may be staggered and the second planting will provide grazing through September.

A recommended variety of oats is planted about September first, at the rate of 4 bushels per acre. The oats are fertilized with 50 pounds available nitrogen, 60 pounds available phosphorous and 60 pounds available potash at planting time. Oats are topdressed with 33 pounds of available nitrogen in December and March if sufficient growth is made for fall grazing.

The oats are usually ready for controlled grazing by the last of October or the first of November. During a severe winter, grazing may have to be discontinued from the last of December to the last of February. Throughout the winter grazing period, the time that the cows graze the oats each day depends upon the amount of forage available. If grazing is very short, the cows are taken off the grass by mid-morning and fed silage. Part time grazing each day is practiced with temporary crops in order to increase the production.

The white clover in the permanent pasture is lush by the first of May. At this time the cows are removed from the oats, put on the permanent pasture, and the oat forage that remains is cut for hay or silage. Millet is planted on the oat land at this time to insure grazing later in the summer when it is needed.

Silage Feeding

Oats, cut in the spring, and millet cut in the summer are ensiled for feeding the dairy herd during winter months. Both of these plants produce good silage.

When grazing is available only part time, silage is fed free choice each day after the cows are removed from the pasture. Whenever the grazing crops are too short to be grazed even part time, the silage is fed free choice after milking each morning. The supply of silage is limited so that it can not be fed every day throughout the winter. It is used to supplement the pastures and add succulence to the ration.

Hay Feeding

Alfalfa hay does an excellent job with the milking herd. When the supply of alfalfa is limited, lespedeza or oat hay is fed. Hay is fed free choice throughout the winter even when the cows are on part time grazing. About two pounds of hay per 100 pounds liveweight is consumed. Good quality hay is especially important when trying to maintain a high level of milk production, during periods that the pastures do not provide adequate forage. On well-drained soils alfalfa produces a high yield of excellent quality feed.

Feeding the Milking Herd

Concentrates, composed primarily of home-grown grains, are fed at the rate of one pound of feed for each three pounds of milk produced. Enough cottonseed meal or soybean meal is added to provide for the protein needs of the cow. A concentrate ration containing 12 to 13 percent crude protein is considered to be adequate when fed with a good quality legume hay. As quality of hay decreases the amount of crude protein in the concentrate is increased. About five percent by weight of molasses and about one percent by weight of salt is added when the feed is mixed by a commercial firm.

During 1959, the ration consisted of the following feeds in the proportions shown.

1250	pounds of crushed corn, cob and shuck meal
400	pounds of crushed oats
240	pounds of protein meal
90	pounds of molasses
20	pounds of salt
2000	Total pounds

Raising Replacement Heifers

Since 1955, the Pontotoc Branch Station has been using a system of calf raising in portable pens. Seventy heifers have been raised with no deaths or serious disease trouble. The success of raising these calves has been attributed to the use of 5' x 10' portable pens and the management practices followed.

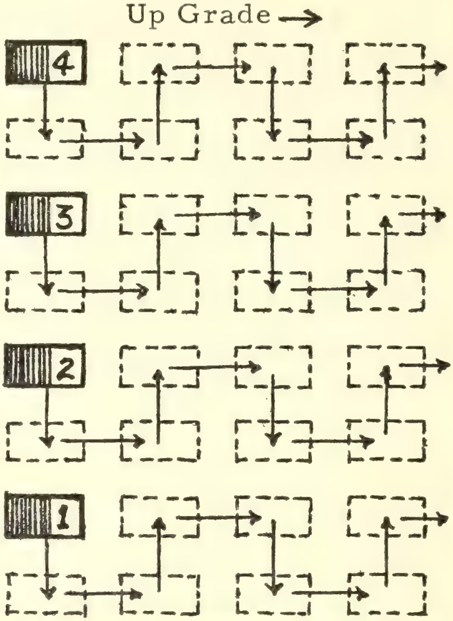
The cows at calving time are kept outside in an area of pasture which is considered not to be heavily contaminated with disease producing organisms. After birth, the calves remain with their dams for at least 24 hours. Then the calf is placed in a portable pen. Oat straw or some other good bedding is kept in the pen at all times. Since colostrum milk

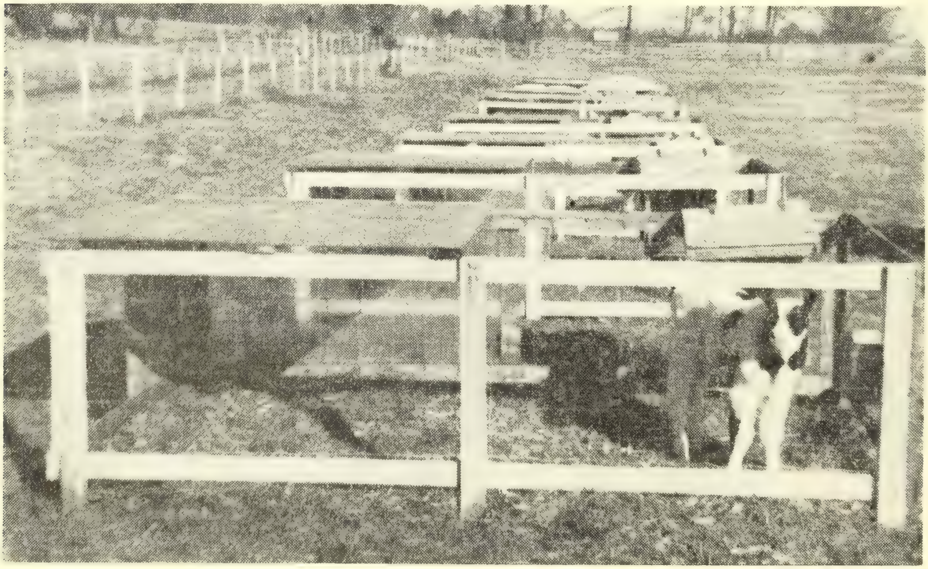
Grazing is an important part of the feeding program.

is necessary for raising good healthy calves, the dam's milk is fed for several days. Milk is fed twice daily in a nipple pail, and one pail is provided for each calf. The amount of milk fed is about 1 pound for each 10 pounds of body weight. This is increased with growth but never exceeds 12 pounds per day.

In addition to milk, the calves are fed a commercial calf starter, legume hay, salt and fresh water. Each calf has its own water pail, feed pail and hay rack. The calves begin eating the calf starter at 7-10 days of age. It is fed free choice and when a calf starts eating 2 to 2½ pounds of the commercial starter, the milk may be reduced or stopped completely at this stage without any ill effect. At three months of age the concentrate fed to the milking herd is added to the starter and at four months the commercial starter is left out. At five months of age calves are vaccinated for brucellosis and black-leg and put in pasture with other calves. They are dehorned at an early age by using a paste or plastic dehorning compound.

The portable pens are placed 7 feet apart in a line at the lower end of the area to be used for raising calves. Once each week the pens are moved to fresh





Calves are raised in individual pens which are moved upgrade to new ground each week.

ground and new bedding is put in. They are moved uphill on a zig-zag course so as to utilize all ground area possible.

The pens are inexpensive and easy to build. The primary materials used are lumber (1" x 4"), net wire and an aluminum top for part of the pen. The roofing is needed for protection from rain, cold, or heat. Protection from wind on the north and west sides of the pen is furnished by plastic or some light-weight material. The pen can be easily disassembled when not in use.

The success of this system of raising calves can be attributed mainly to sanitation in feeding and the weekly movement of pens to clean ground.

Management of Older Heifers

When calves are taken out of the portable pens, they are kept in groups away from larger and older animals. Pasture provides the feed for these heifers and is supplemented with grain when the quality goes down in the late summer. As soon as winter grazing is available the heifers obtain the needed nutrients from this source.

In late winter, it is usually necessary to remove the heifers from the cereal crops. When this is done they are put into a lot with shelter and fed silage, hay and a concentrate of crushed corn, cob and shuck meal and a protein meal. This grazing and feeding program is followed until the heifers are put into the milking herd. The thrifty heifers are bred to calve at the age of two years unless this results in the calf being dropped at an undesirable time. Others are bred according to their growth and development.

Dry Cows

Pasture provides the major portion of the feed fed to dry cows. As long as good lush pasture is available the dry cows will obtain their needed nutrients. When the quality of the pasture drops, the dry cows are fed a concentrate of crushed ear corn and protein meal. When grazing is not available, the dry cows are fed a ration of silage, hay and a concentrate of crushed ear corn and protein meal. The concentrate ration is usually mixed in a ratio of 100 pounds of protein meal to 600 pounds of corn and fed in varying amounts according to roughage available.

Table 1. Annual feed consumption and pasture utilization by the dairy enterprise, Pontotoc Branch Experiment Station for the period June 1, 1957 - May 31, 1959.

	Total used by			Total used per cow by[1]		
Item	Cows	Replacements	Herd	Cow	Replacement	Herd
Feed:						
Concentrates, cwt.	1,217	428	1,645	29.54	10.39	39.93
Hay, tons	52	16	68	1.27	.38	1.65
Silage, tons	78	23	101	1.88	.57	2.45
Total roughage hay equivalent, tons[2]	78	23	101	1.88	.57	2.45
Grazing (acres):						
Permanent pasture	42	13	55	1.03	.31	1.34
Temporary winter pasture[3]	12	3	15	.28	.08	.36
Temporary summer pasture	(12)	(3)	(15)	(.28)	(.08)	(.36)
Total	54	16	70	1.31	.39	1.70

[1] Separate records were kept on amount of concentrates fed to cows and replacements. Separate records were not kept on roughage and grazing; the amount of roughage and grazing was determined on an animal-unit basis with an animal equal to one cow over 2 years old, 2 heifers 1-2 years old and 4 heifers under 1 year old.

[2] Silage converted to hay equivalent by dividing by 3.

[3] Land used for temporary winter grazing was used to produce temporary summer grazing with hay or silage being harvested off last growth of oats and millet.

Financial Summary

During the two-year period analyzed, June 1, 1957 - May 31, 1959, the herd averaged 41 cows, 17 heifers from 1 to 2 years of age and 15 heifer calves under one year of age, or 53.6 animal units.

An average of 1,645 hundredweights of concentrates, 68 tons of hay and 101 tons of silage was fed to the herd per year. Grazing was provided by 55 acres of permanent pasture, 15 acres of temporary winter pasture and 15 acres of temporary summer pasture, Table 1.

Annual feed consumption per cow averaged 2,954 pounds of concentrates, 1.27 tons of hay and 1.88 tons of silage. However, annual feed consumption per cow for the herd, including the amount fed to replacement animals raised, averaged 3,993 pounds of concentrates, 1.65 tons of hay and 2.45 tons of silage. On the same basis, pasture utilized per cow for the herd averaged 1.34 acres of permanent pasture, .36 acres of temporary winter pasture and .36 acres of temporary summer pasture.

Costs: Farmers are concerned with the returns that can be obtained with a given amount of resources; therefore, it was thought that returns to labor and capital would be more meaningful than net

Table 2. Annual returns to labor and capital for dairy operation at manufactured milk prices, Pontotoc Branch Experiment Station for the period June 1, 1957 - May 31, 1959.

	Cost and return		
Item	Herd	Per cow	Per 100 lbs. milk
Feed cost:[1]			
Concentrates	$ 4,325	$105	$1.28
Hay	1,476	36	.44
Silage	705	17	.21
Total	$ 6,506	$158	$1.92
Pasture cost:			
Fertilizer	$ 1,040	$ 25	$ .31
Seed	259	6	.08
Land preparation, seeding, applying fertilizer and mowing	875	21	.26
Less value of hay harvested	300	7	.09
Total	$ 1,874	$ 45	$ .55
Other:			
Hauling and ADA	$ 1,423	$ 35	$ .42
Veterinary & breeding	566	14	.17
Miscellaneous	429	10	.13
Total	$ 2,418	$ 59	$ .72
Total cost[2]	$10,798	$262	$3.19
Less cattle sales	1,184	29	.35
Less increase in inventory[3]	1,788	43	.53
Cost of producing milk	$ 7,826	$190	$2.31
Value of milk produced	$10,992	$267	$3.24
Less cost of producing milk	7,826	190	2.31
Returns to labor and capital	$3,166	$ 77	$ .93

[1] Feed charged at market prices.

[2] Does not include a charge for the following items: (1) labor, (2) interest on investment in land, cattle, buildings, equipment and fencing, and (3) depreciation on buildings, equipment and fencing.

[3] Cows were valued at $225, 2-year-old heifers at $175, 1-2 year-old heifers at $125 and heifer calves at $75.

returns. For this reason charges for labor and capital were not included in calculating costs.

In calculating feed costs, concentrates and hay were charged at the average prices paid by Mississippi farmers. Silage was charged to the dairy enterprise at approximately one-third of the cost of hay.

Pasture costs were calculated as follows: seed and fertilizer were charged at the average prices paid by Mississippi farmers. Land preparation, seeding, applying fertilizer and mowing were charged at the usual custom rates. Pasture cost was reduced by the value of roughage harvested from the pasture acreage less the cost of harvesting.

Other costs were those paid by the Pontotoc Branch Station for supplies and services used in the dairy operation.

Total annual cost amounted to $10,798 for the herd and $262 per cow, Table 2. Feed and pasture were the most important items of cost. Concentrates accounted for 40 percent of total cost, roughage for 20 percent and pastures for 17 percent. The cost of producing milk was calculated by deducting the value of cattle sold and increases in the cattle inventory from total herd cost. The annual cost of producing milk averaged $190 per cow and $2.31 per 100 pounds of milk.

Returns: Annual milk production amounted to 338,841 pounds for the herd and 8,224 pounds per cow. The annual value of milk produced amounted to $10,992 for the herd, $267 per cow and $3.24 per 100 pounds. Annual returns to labor and capital averaged $3,166 for the herd, $77 per cow and $0.93 per 100 pounds of milk.

Applications of Results to a Dairy Farm

Many dairy farmers produce all of their grain and roughage. For this reason it was felt that the results obtained on the Pontotoc Branch Station would

Table 3. Estimated annual requirements for feed and grazing crops for a dairy farm producing milk for manufacturing, operated under specified conditions, for the period June 1, 1957 - May 31, 1959.

	Total used by			Total per cow used by		
Item	Cows	Replacements	Herd	Cows	Replacements	Herd
Feed:[1]						
Concentrates, cwt.	1,217	428	1,645	29.54	10.39	39.93
Hay, tons	52	16	68	1.27	.38	1.65
Silage, tons	78	23	101	1.88	.57	2.45
Total roughage hay equivalent, tons	78	23	101	1.88	.57	2.45
Feed crops (acres):						
Corn	20	8	28	.49	.19	.68
Oats for grain	20	1	21	.49	.02	.51
Oats for hay & silage[2]	15	5	20	.37	.12	.49
(Lespedeza for hay)	(15)	(5)	(20)	(.37)	(.12)	(.49)
(Millet for silage)[3]	(12)	(3)	(15)	(.29)	(.07)	(.36)
Total	55	14	69	1.35	.33	1.68
Grazing (acres):						
Permanent pasture	42	13	55	1.03	.31	1.34
Temporary winter pasture[4]	12	3	15	.29	.07	.36
Temporary summer pasture	(12)	(3)	(15)	(.29)	(.07)	.36
Total	54	16	70	1.32	.38	1.70
Total acres utilized	109	30	139	2.65	.73	3.38

[1] Same amount of feed as fed by Pontotoc Branch Station as shown in Table 1.

[2] Twenty acres of oats grazed until February 1, 14 acres out for hay and 6 acres out for silage. Same land sowed with lespedeza and cut for hay.

[3] Silage harvested from 15 acres of temporary summer grazing (millet).

[4] Fifteen acres of oats grazed until April 10, cut for hay and planted in millet.

be more applicable to the usual dairy farm operation if all of the grain and roughage were produced and costs and returns calculated for the dairy farm instead of for the dairy enterprise.

In these calculations the herd size, milk production, the amount of concentrates, hay and silage fed and the pasture acreage utilized are the same as reported for the dairy enterprise at the Pontotoc Branch Station. The only changes are: (1) an additional 69 acres of cropland would be required to grow the needed amount of corn, oats, hay and silage and (2) the operator would own his machinery and perform all operations involved in producing and harvesting feed and grazing crops with one exception. Enough acreage of oats for grain was planted to raise the needed amount of oats for feed and one-fourth share for custom harvesting. The production of these crops involves considerable additional capital investment in land and machinery and requires additional labor.

Very little alfalfa hay is produced by dairy farmers of Mississippi; therefore, it was assumed that a lower quality hay (oat and lespedeza) would be produced on the dairy farm. The change in kind of hay made it necessary to change the concentrate ration from a 12 to 16 percent crude protein. Composition of the ration fed to the milking herd and calves was changed in kind and amount of different feeds. One thousand pounds of the following mixture will provide a 16 percent crude protein mixture: 526

Table 4. Estimated annual returns to labor and capital for a dairy farm, producing milk for manufacturing, operated under specified conditions for the period June 1, 1957 - May 31, 1959.

Item	Cost and return		
	Herd	Per cow	Per 100 lbs. milk
Feed cost:			
Concentrates	$ 2,849	$ 69	$ .84
Hay	765	19	.23
Silage	141	3	.04
Total	$ 3,755	$ 91	$1.11
Pasture cost:			
Fertilizer	$ 1,040	$ 25	$ .31
Seed	259	6	.08
Machinery operation	239	6	.07
Total	$ 1,538	$ 37	$ .46
Other costs:			
Hauling and ADA	$ 1,423	$ 35	$ .42
Veterinary and breeding	566	14	.17
Miscellaneous	429	10	.13
Total	$ 2,418	$ 59	$ .72
Total cost[1]	$ 7,711	$187	$2.28
Less cattle sales	1,184	29	.35
Less increase in inventory[2]	1,788	43	.53
Cost of producing milk	$ 4,739	$115	$1.40
Value of milk produced	$10,992	$267	$3.24
Less cost of producing milk	4,739	115	1.40
Returns to labor and capital	$ 6,253	$152	$1.84

[1] Does not include a charge for the following items: (1) labor, (2) interest on investment in land, cattle, buildings, equipment and fencing and (3) depreciation on buildings and fencing.

[2] Cows were valued at $225, 2 year-old heifers at $175, 1-2 year-old heifers at $125 and heifer calves at $75.

pounds of crushed corn, cob and shuck meal, 263 pounds of oats, 201 pounds of cottonseed meal and 10 pounds of salt. A cheaper feed could possibly be fed during those periods when plenty of good grazing is available by reducing the protein content of the ration.

Costs: In estimating costs, feed purchased was charged at the average prices paid by Mississippi farmers, and corn, oats, hay and silage were charged at the cost of production .

Total annual cost amounted to $7,711 for the herd and $187 per cow, Table 4. Concentrates accounted for 37 percent of total cost, roughage for 12 percent and pastures for 20 percent. The annual cost of producing milk, total herd cost less the value of cattle sold and increases in the cattle inventory averaged $115 per cow and $1.40 per 100 pounds of milk.

Returns: Annual returns to labor and capital for the dairy farm operation averaged $6,253 as compared to $3,166 for the dairy enterprise. By producing all grain and forage crops on the farm with his own labor and machinery, it appears that the dairyman would almost double his return to labor and capital. In making this comparison, the dairyman must take into consideration: (1) the additional capital investment required in land and machinery and (2) the additional labor required to produce the crops.

BULLETIN 591 APRIL 1960

An Economic Evaluation of

Alternative Methods Of Beef Production

In The Prairie Area of Mississippi

Information on when to sell calves and how to manage them until sale is provided in this Experiment Station study.

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

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An Economic Evaluation of Alternative Methods of Beef Production in the Prairie Area of Mississippi

By THOMAS E. TRAMEL, DONALD LEE MOTT,
and C. E. LINDLEY*

In recent years there has been a decided trend in Mississippi toward diverting land from cash crops to pasture and feed crops. This has been brought about by governmental restrictions on basic cash crops, improved technology in the livestock industry, and an increased demand for livestock and meat products. It seems quite likely that the trend will continue.

Cattle numbers in Mississippi have almost doubled in the last decade, with most of the increase being in beef cattle.

Forage from permanent pasture is a primary resource for beef cattle in Mississippi. There are several alternative systems or methods of beef production by which permanent pasture forage may be utilized (Appendix Tables 1, 2, and 3). Which of these methods is likely to return the greatest profits is an important question facing beef producers of the state. In addition, they face the problem of determining the best level of pasture improvement.

It was the purpose of this study to help answer these questions. Specifically, the objective was to determine the net returns per acre of permanent pasture which might be expected from alternative systems of beef production for two levels of pasture improvement.

Fourteen different methods of beef production were studied for each of two levels of pasture improvement. Each method was of the cow-calf type, relying upon a high quality breeding herd to raise all calves and replacement heifers; only bulls were purchased. Methods of production were classified on the following basis: (1) spring or fall calving, (2) age at which calves were marketed, (3) type of winter ration, and (4) whether calves received concentrate feeding in addition to permanent pasture prior to marketing.

An annual budget, including grazing requirements for the entire herd, costs, and returns, was prepared for each of the 14 alternative methods for each of the two levels of pasture improvement.

The two levels of pasture improvement considered were (1) native pastures, and (2) pastures improved to the average level of all improved pastures found in a recent survey.[1] Carrying capacities per acre and annual pasture improvement costs were obtained from the survey just mentioned. To correspond to these pasture costs, prices for all other items were adjusted to the 1951-56 average. Costs included were: feed, permanent pasture costs, temporary winter pasture when needed for a particular system, labor, marketing, bull replacement, and miscellaneous.

Grazing available from permanent pastures, April to October, after harvesting the amount of hay needed was considered as the one factor limiting the size of the beef enterprise for each 100 acres.

Grazing available from permanent pasture in other months was considered as supplementary to the feeding program.

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*Agricultural Economist, Research Associate, and Head of the Department of Animal Husbandry, respectively.

This project was financed in part from regional funds under S-27.

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[1] Thomas E. Tramel, D. W. Parvin, and J. E. Betts, **Farm Pastures of the Prairie Area of Mississippi,** Mississippi Agricultural Experiment Station Bulletin 585.

Table 1. Summary of costs and returns per 100 acres of native open permanent pasture, 14 methods of handling cow-calf beef herds, Prairie Area Mississippi, 1956.

	Method of handling cow-calf beef herd													
	Fall calves				Spring calves									
Item	Sold at weaning	Perm. pasture and feed	Perm. pasture and temp. winter pasture	Perm. pasture temp. winter pasture and perm. pasture and feed	Sold at weaning	Roughed through winter and perm. pasture and feed	Roughed through winter and perm. pasture	Roughed through winter perm. pasture and roughed through winter	Roughed through winter perm. pasture roughed through winter and perm. pasture	Roughed through winter perm. pasture roughed through winter and perm. pasture and feed	Roughed through winter perm. pasture and temp. winter pasture	Roughed through winter perm. pasture temp. winter pasture and perm. pasture and feed	Temp. winter pasture	Temp. winter pasture and perm. pasture and feed
Brood cows (No.)	25	24	23	21	25	21	20	19	14	15	20	18	25	23
Ages at which calves sold (mos.)	7.5	11.5	19.0	23.0	7.5	19.5	19.5	24.0	31.5	31.5	27.0	31.5	15.0	19.5
Weight of calves sold (lbs.)	450	700	750	1,000	350	900	800	750	900	1,000	900	1,075	700	850
Price per cwt. for calves (dol.)	20.18	23.81	20.70	23.85	16.56	23.07	18.40	19.96	18.51	23.85	20.67	23.85	20.70	23.76
Returns from calves, steers and heifers (dol.)	1,467	2,450	2,142	3,018	995	2,647	1,784	1,713	1,387	2,127	2,229	2,744	2,187	2,818
Returns from cull cows and cull bulls (dol.)	572	549	526	481	572	481	458	435	320	343	458	412	572	526
Total returns (dol.)	2,039	2,999	2,668	3,499	1,567	3,128	2,242	2,148	1,707	2,470	2,687	3,156	2,759	3,344
Feed costs (dol.)	948	1,582	873	1,590	599	1,355	642	824	604	1,201	643	1,245	598	1,303
Permanent pasture costs (dol.)[1]	81	81	81	81	81	81	81	81	81	81	81	81	81	81
Temporary winter pasture costs (dol.)	0	0	650	594	0	0	0	0	0	0	601	541	536	493
Labor costs (dol.)	171	186	193	202	181	227	212	235	190	209	233	229	207	216
Marketing costs (dol.)	75	103	93	116	61	105	79	75	59	82	92	106	97	113
Other costs (dol.)	211	210	206	196	213	194	184	181	138	149	191	178	221	211
Total costs (dol.)	1,486	2,162	2,096	2,779	1,135	1,962	1,198	1,396	1,072	1,722	1,841	2,380	1,740	2,417
Net returns per 100 ac. (dol.)	553	837	572	720	432	1,166	1,044	752	635	748	846	776	1,019	927

---

[1] Includes only labor, power, equipment, and materials cost for land preparation, fertilization, and seeding.

Table 2. Summary of costs and returns per 100 acres of open permanent pasture improved to the average level of improvement for 1956, 14 methods of handling cow-calf beef herds, Prairie Area, Mississippi.

	Method of handling cow-calf beef herd													
	Fall calves				Spring calves									
Item	Sold at weaning	Perm. pasture and feed	Perm. pasture and temp. winter pasture	Perm. pasture temp. winter pasture and perm. pasture and feed	Sold at weaning	Roughed through winter and perm. pasture and feed	Roughed through winter and perm. pasture	Roughed through winter perm. pasture and roughed through winter	Roughed through winter perm. pasture roughed through winter and perm. pasture	Roughed through winter perm. pasture roughed through winter and perm. pasture and feed	Roughed through winter perm. pasture and temp. winter pasture	Roughed through winter perm. pasture temp. winter pasture and perm. pasture and feed	Temp. winter pasture	Temp. winter pasture and perm. pasture and feed
Brood cows (No.)	32	31	31	28	33	27	26	25	19	20	26	23	33	30
Age at which calves sold (mos.)	7.5	11.5	19.0	23.0	7.5	19.5	19.5	24.0	31.5	31.5	27.0	31.5	15.0	19.5
Weight of calves sold (lbs.)	475	725	800	1,050	375	950	850	800	1,000	1,100	950	1,150	725	900
Price per cwt. for calves (dol.)	20.18	24.33	22.07	25.42	16.56	24.63	21.94	22.15	22.28	25.41	22.07	25.41	22.07	25.29
Returns from calves, steers and heifers (dol.)	2,017	3,401	3,300	4,502	1,449	3,835	2,938	2,667	2,517	3,324	3,265	3,997	3,211	4,142
Returns from cull cows and cull bulls (dol.)	732	709	709	641	755	618	595	572	435	458	595	526	755	687
Total returns (dol.)	2,749	4,110	4,009	5,143	2,204	4,453	3,533	3,239	2,952	3,782	3,860	4,523	3,966	4,829
Feed costs (dol.)	1,188	2,016	1,160	2,101	775	1,723	818	1,064	809	1,585	820	1,574	772	1,684
Permanent pasture costs (dol.)[1]	344	344	344	344	344	344	344	344	344	344	344	344	344	344
Temporary winter pasture costs (dol.)	0	0	876	791	0	0	0	0	0	0	781	691	707	643
Labor costs (dol.)	219	240	260	269	239	291	276	310	258	279	302	293	273	282
Marketing costs (dol.)	101	141	138	170	85	149	120	111	99	124	130	148	137	162
Other costs (dol.)	270	271	278	261	281	249	239	238	188	199	249	227	292	275
Total costs (dol.)	2,122	3,012	3,056	3,936	1,724	2,756	1,797	2,067	1,698	2,531	2,626	3,277	2,525	3,390
Net returns per 100 ac. (dol.)	627	1,098	953	1,207	480	1,697	1,736	1,172	1,254	1,251	1,234	1,246	1,441	1,439
Net returns above native pastures per 100 acres (dol.)	74	261	381	487	48	531	692	420	619	503	388	470	422	512

[1] Includes only labor, power, equipment, and materials cost for land preparation, fertilization, and seeding.

Temporary winter pasture, when needed for a particular system of production, was assumed to be planted in the ratio of two acres on permanent pasture sod to one on cropland.

Native Pastures

For this level of pasture improvement, selling spring calves at weaning results in lower net returns per 100 acres of pasture than any of the 14 alternative methods studied (Table 1).

The best alternatives appear to be: (1) roughing spring calves through the first winter and feeding out on permanent pasture the second summer, (2) roughing spring calves through the first winter and grazing permanent pasture the second summer, (3) grazing spring calves on temporary winter pasture the first winter and selling, or (4) grazing spring calves on temporary winter pasture the first winter and feeding out on permanent pasture prior to sale.

Net returns from the 14 alternative methods of production ranged from $432 per 100 acres to $1,166 per 100 acres.

Improved Pastures

Selling spring calves at weaning appears to be the least profitable of any of the 14 alternatives for this level of pasture improvement also (Table 2). Likewise, the same four alternatives as for native pastures appear to be the best. Net returns per 100 acres ranged from $480 to $1,736.

Comparison of Net Returns for the Two Levels of Improvement

Difference in net returns per 100 acres depend upon the manner in which the grazing is utilized. For each of the 14 methods of beef production studied, the added cost of pasture improvement ($263 annually per 100 acres) more than paid for itself. However, for both spring calves sold at weaning and fall calves sold at weaning, the rate of return was rather low, $48 and $74 per 100 acres, respectively. Net returns per 100 acres for the added cost of pasture improvement range up to $692 for spring calves roughed through the first winter and grazed on permanent pasture the second summer.

Utilization of Grazing

The proportion of the total grazing used which is required for the brood herd and replacements appears to be one of the primary factors influencing profits from the beef enterprise. About 90 percent of the total grazing is required for the brood herd and replacements when calves are sold at weaning. In contrast, for the four most profitable alternatives the percentage ranged from 66 to 74.

Summary and Conclusions

Beef producers are faced with a choice of many alternative systems or methods of production, as well as the question of whether pasture improvement pays.

This study was made for the purpose of determining which of 14 methods of beef production of the cow-calf type that were considered feasible would likely be most profitable for two levels of pasture improvement. The two levels of improvement considered were (1) native pastures and (2) pastures improved to the average level of all pastures which were found to be improved in a recent survey of the Prairie Area of the state.

For both levels of pasture improvement, selling spring calves at weaning appeared to be the least profitable of any of the 14 alternatives considered. On the other hand, for both levels of pasture improvement, the best alternatives appeared to be:

(1) Roughing spring calves through the first winter and feeding out on permanent pasture the second summer,

(2) Roughing spring calves through the first winter and grazing permanent pasture the second summer,

(3) Grazing spring calves on temporary winter pastures the first winter,

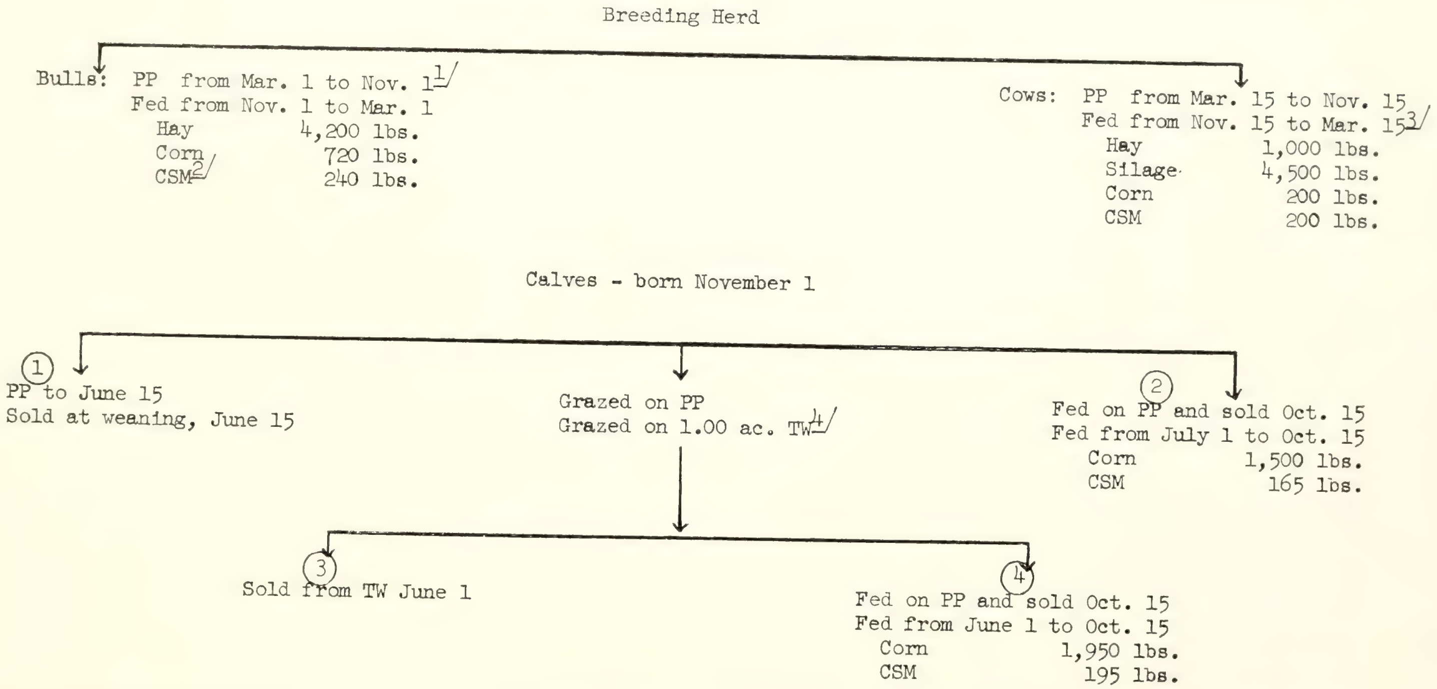
(4) Grazing spring calves on temporary winter pasture the first winter and feeding out on permanent pasture,

Net returns per 100 acres ranged from $432 to $1,166 for the native pastures and from $480 to $1,736 for the improved pastures.

Additional labor and additional investment in the beef herd is required for carrying calves beyond the weaning age. However, the added net returns would seem to be ample reward for doing so.

Net returns from pasture improvement depend upon the manner in which the forage is utilized. Net returns from pasture improvement would be only about $48 and $74 per 100 acres for spring calves sold at weaning and fall calves calves sold at weaning, respectively. On the other hand, net returns from the added $263 per 100 acres annual improvement cost ranged up to $692 for spring calves roughed through the first winter and grazed on permanent pasture the second summer.

Appendix Table 1. Alternative methods of beef production from a fall calving system.


Breeding Herd
Bulls: PP from Mar. 1 to Nov. 1[1]
Fed from Nov. 1 to Mar. 1
Hay 4,200 lbs.
Corn 720 lbs.
CSM[2] 240 lbs.
Cows: PP from Mar. 15 to Nov. 15
Fed from Nov. 15 to Mar. 15[3]
Hay 1,000 lbs.
Silage 4,500 lbs.
Corn 200 lbs.
CSM 200 lbs.
Calves - born November 1
①
PP to June 15
Sold at weaning, June 15
Grazed on PP
Grazed on 1.00 ac. TW[4]
②
Fed on PP and sold Oct. 15
Fed from July 1 to Oct. 15
Corn 1,500 lbs.
CSM 165 lbs.
③
Sold from TW June 1
④
Fed on PP and sold Oct. 15
Fed from June 1 to Oct. 15
Corn 1,950 lbs.
CSM 195 lbs.

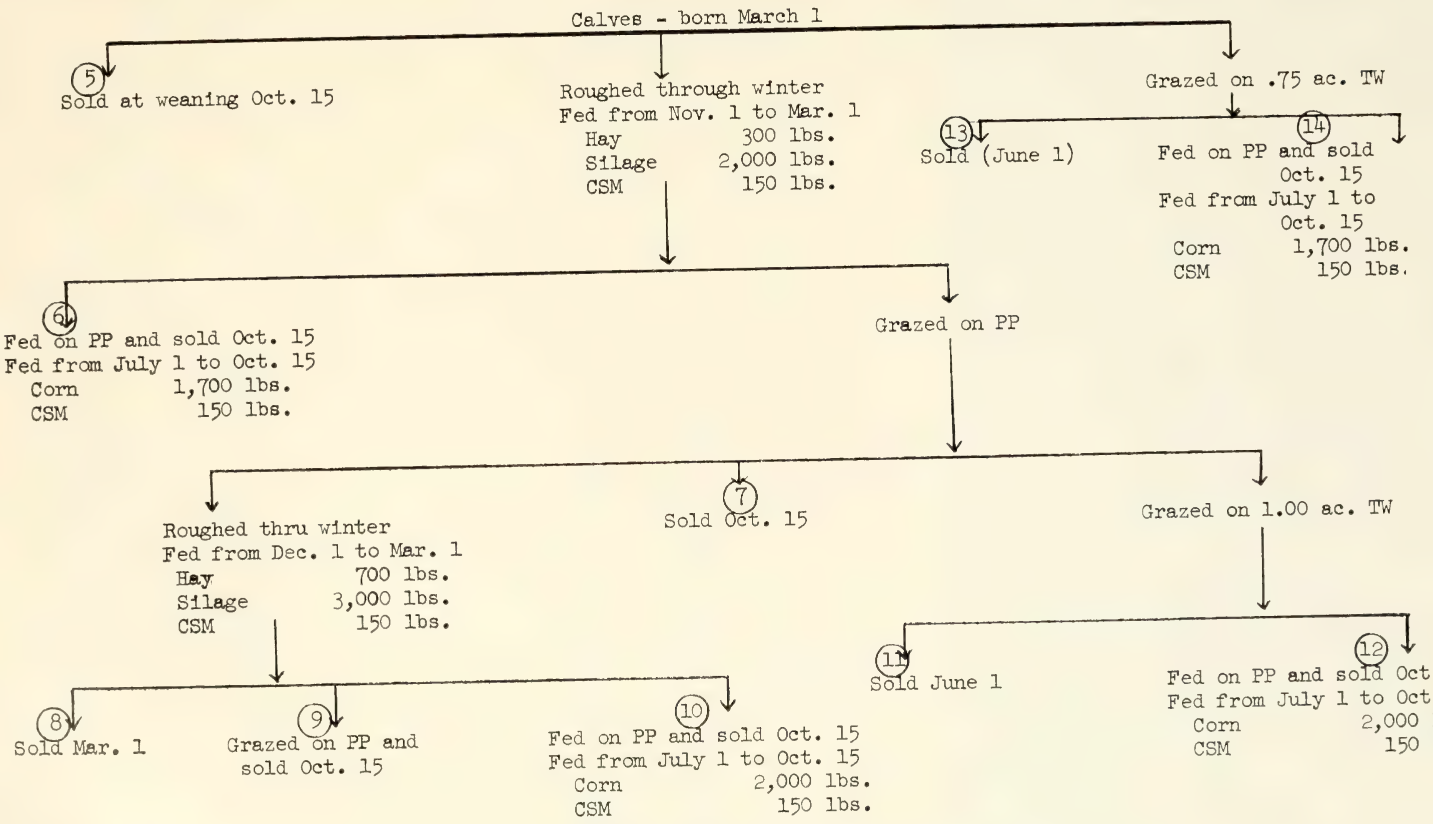
---

[1] PP denotes permanent pasture. [2] CSM denotes cottonseed meal.

[3] Feed requirements for brood cows calving in the spring would be: Hay, 500 pounds; silage, 3,000 pounds; and cottonseed meal, 100 pounds.

[4] TW denotes oats for temporary winter pasture - the acreages listed refer to acres on cropland or its equivalent on sod-seeded permanent pasture.

Appendix Table 2. Alternative methods of beef production from a spring calving system.[1]


Calves - born March 1
⑤ Sold at weaning Oct. 15
Roughed through winter
Fed from Nov. 1 to Mar. 1
Hay 300 lbs.
Silage 2,000 lbs.
CSM 150 lbs.
Grazed on .75 ac. TW
⑬ Sold (June 1)
⑭ Fed on PP and sold Oct. 15
Fed from July 1 to Oct. 15
Corn 1,700 lbs.
CSM 150 lbs.
⑥ Fed on PP and sold Oct. 15
Fed from July 1 to Oct. 15
Corn 1,700 lbs.
CSM 150 lbs.
Grazed on PP
Roughed thru winter
Fed from Dec. 1 to Mar. 1
Hay 700 lbs.
Silage 3,000 lbs.
CSM 150 lbs.
⑦ Sold Oct. 15
Grazed on 1.00 ac. TW
⑧ Sold Mar. 1
⑨ Grazed on PP and sold Oct. 15
⑩ Fed on PP and sold Oct. 15
Fed from July 1 to Oct. 15
Corn 2,000 lbs.
CSM 150 lbs.
⑪ Sold June 1
⑫ Fed on PP and sold Oct. 15
Fed from July 1 to Oct. 15
Corn 2,000 lbs.
CSM 150 lbs.

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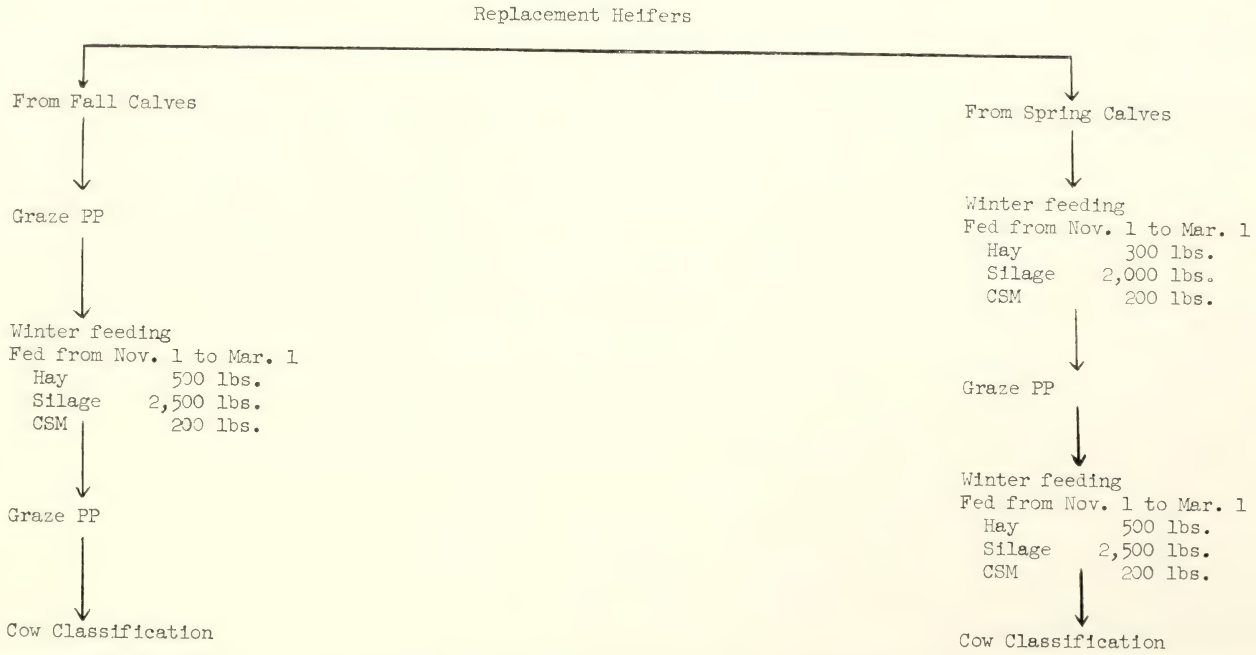
[1] See footnotes to Appendix Table 1.

Appendix Table 3. Method of raising replacement heifers from spring and fall calves.[1]


Replacement Heifers
From Fall Calves
Graze PP
Winter feeding
Fed from Nov. 1 to Mar. 1
Hay 500 lbs.
Silage 2,500 lbs.
CSM 200 lbs.
Graze PP
Cow Classification
From Spring Calves
Winter feeding
Fed from Nov. 1 to Mar. 1
Hay 300 lbs.
Silage 2,000 lbs.
CSM 200 lbs.
Graze PP
Winter feeding
Fed from Nov. 1 to Mar. 1
Hay 500 lbs.
Silage 2,500 lbs.
CSM 200 lbs.
Cow Classification

---

[1] See footnotes to Appendix Table 1.

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A Combination
Anhydrous Ammonia Applicator and Four-Row Bedder

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

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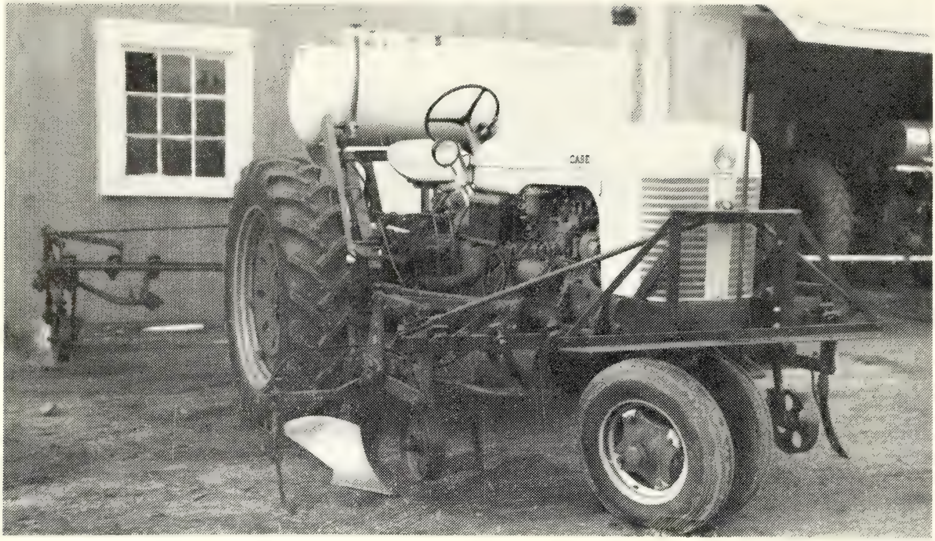


Figure 1. Front view of a 5-row middlebreaker equipped with chemical applicators.

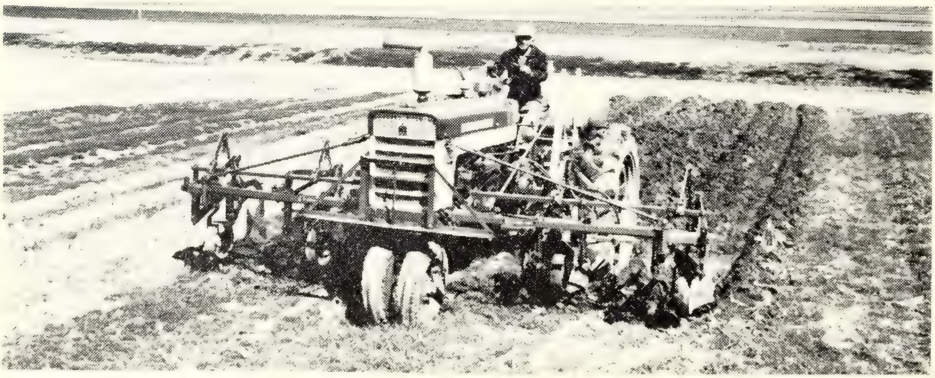


Figure 2. This tractor is equipped for applying anhydrous ammonia and preparing four uniform seedbeds in 1 operation.

Front Cover. —The combination applicator and bedder is preparing 4 uniform beds and applying anhydrous ammonia in the same operation.

A Combination Anhydrous Ammonia Applicator and Four-Row Bedder

By O. B. WOOTEN, F. E. FULGHAM
and E. B. WILLIAMSON[1]

Planting with four-row equipment on beds formed with a three-row middlebreaker is a problem that has confronted row-crop farmers for many years. This is understandable since a four-row planter must straddle a "guess row" on each trip across the field. The "guess row" is an outside row which is partially formed by the middlebreaker during one trip across the field and is completed on the return trip. It generally varies in shape and width, even when a row marker is used in laying out the rows.

Uneven row spacing usually results in a poor job of planting with four-row equipment. One or more of the planter units will tend to run to the side of wide or narrow beds. Under conditions of extreme row variation, at least one of the planting units may end up depositing seed in the row middle. This often results in skippy or uneven stands and adversely affects later cultural practices.

The recent development of a combination chemical applicator and four-row bedder by the mechanization project at Stoneville provides a practical solution to the problem of off-center planting. This work was begun in 1949, when agricultural engineers mounted four anhydrous ammonia applicator knives on the front beams of a three-row middlebreaker. This arrangement was not entirely satisfactory since it was necessary to split the liquid ammonia to be distributed by the two outside knives.

Later investigations consisted of attaching four applicator knives to a rear-mounted toolbar which could be operated in conjunction with a standard front-mounted cultivator equipped with middlebreaker shapes. This setup was not acceptable since the four applicator knives could not be operated at a uniform depth in the beds.

A new approach to the problem in 1954 resulted in the development of a combination four-row chemical applicator and bedder (front cover). Standard farm machinery items used in the first successful model included the two front units of a conventional three-row middlebreaker, a rear-mounted toolbar, and anhydrous ammonia application equipment. Four applicator knives were mounted on specially-designed crossbeams attached to the main beams supporting the two inside front middlebreaker bottoms (Fig. 1).

Three additional middlebreaker plows were mounted on the rear toolbar to permit the formation of either four or five beds simultaneously. Each plow was equipped with a separate gauge wheel and was suspended from the toolbar by parallel-acting linkage. This provided a positive means of getting all bottoms to operate at a predetermined depth. The outside bottoms were designed to operate at half the normal plowing depth since they would travel twice in the same furrow. This was necessary in order to form four uniform beds with the five-bottom middlebreaker.

Several farm equipment companies are currently manufacturing new types of five-row middlebreakers. These machines fully utilize the increased horsepower which is available in late-model tractors.

---

[1] Agricultural Engineers, Agricultural Engineering Research Division, Agricultural Research Service, United States Department of Agriculture, and the Mississippi Agricultural Experiment Station. The work described was done in cooperation with the Delta Branch, Mississippi Agricultural Experiment Station, Stoneville, Mississippi.

In addition, they can be fitted with application equipment for injecting anhydrous ammonia, liquid fertilizers, fungicides, and other liquid chemicals in the soil (Figure 2).

In order to fully utilize all of the improvements included in the design of the combination anhydrous ammonia applicator and bedder, and to provide maximum uniformity for planting with four-row planters, the five-row middlebreaker should be used to bed only four rows.

The first step in mounting the applicators consists of attaching square toolbars of high-carbon steel to the inside middlebreaker beams. The toolbars can be fabricated from 1-1/4, 1-3/8, or 1-7/16-inch square stock, or a square cultivator

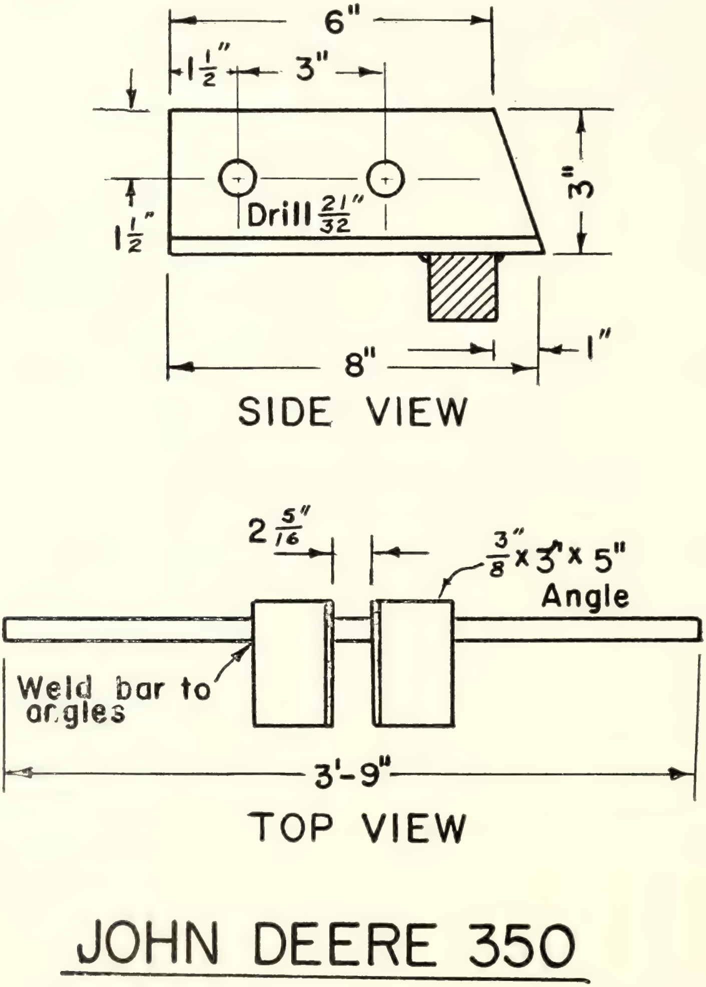


Figure 3. Special toolbar for mounting applicator knives on a John Deere 350 5-row middlebreaker. On this middlebreaker 4 bottoms are mounted in front of the rear axle and 1 behind.
Note: 2 required per middlebreaker.

toolbar can be used, if available. Standard cultivator clamps which are used for attaching round shank standards to square toolbars can be used satisfactorily. Toolbars for three late-model middlebreakers are shown in Figures 3-5. Bars for other

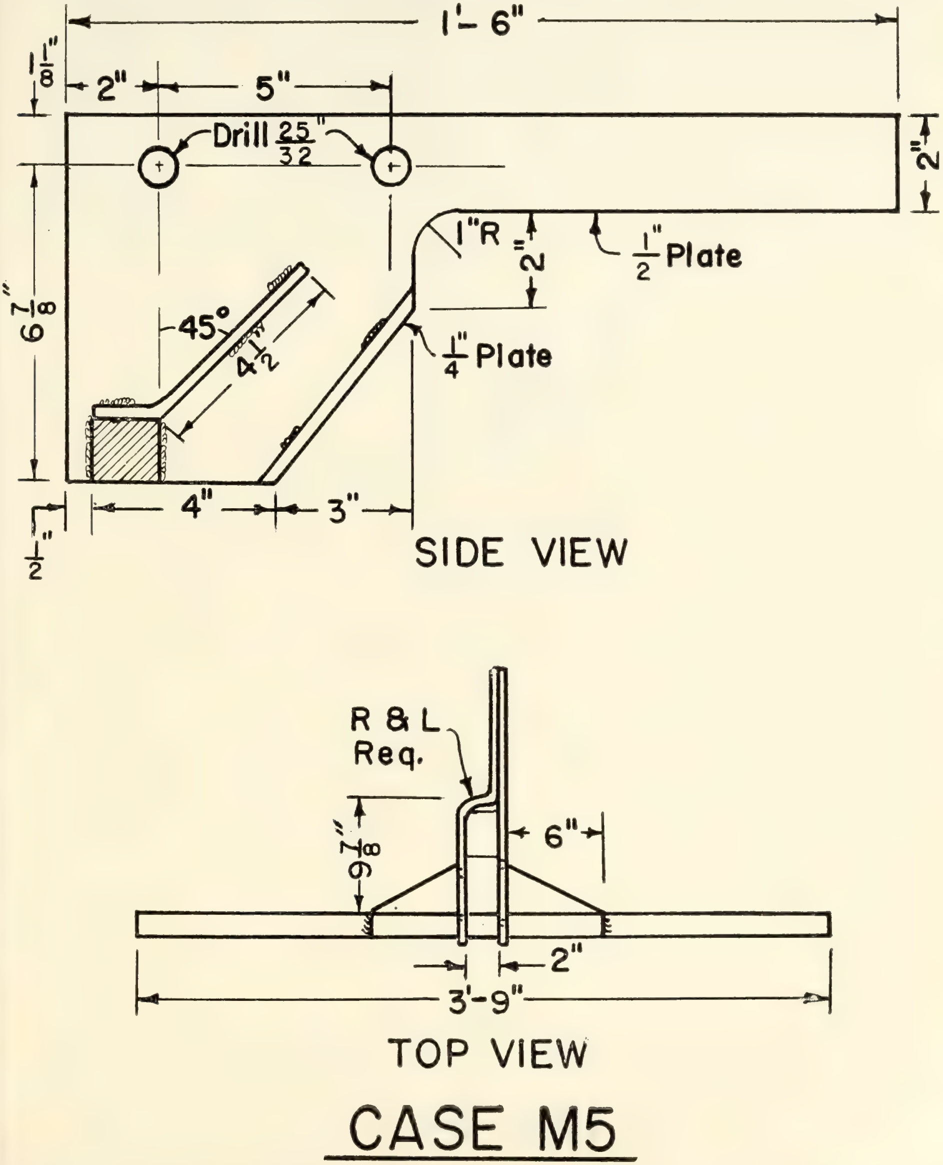
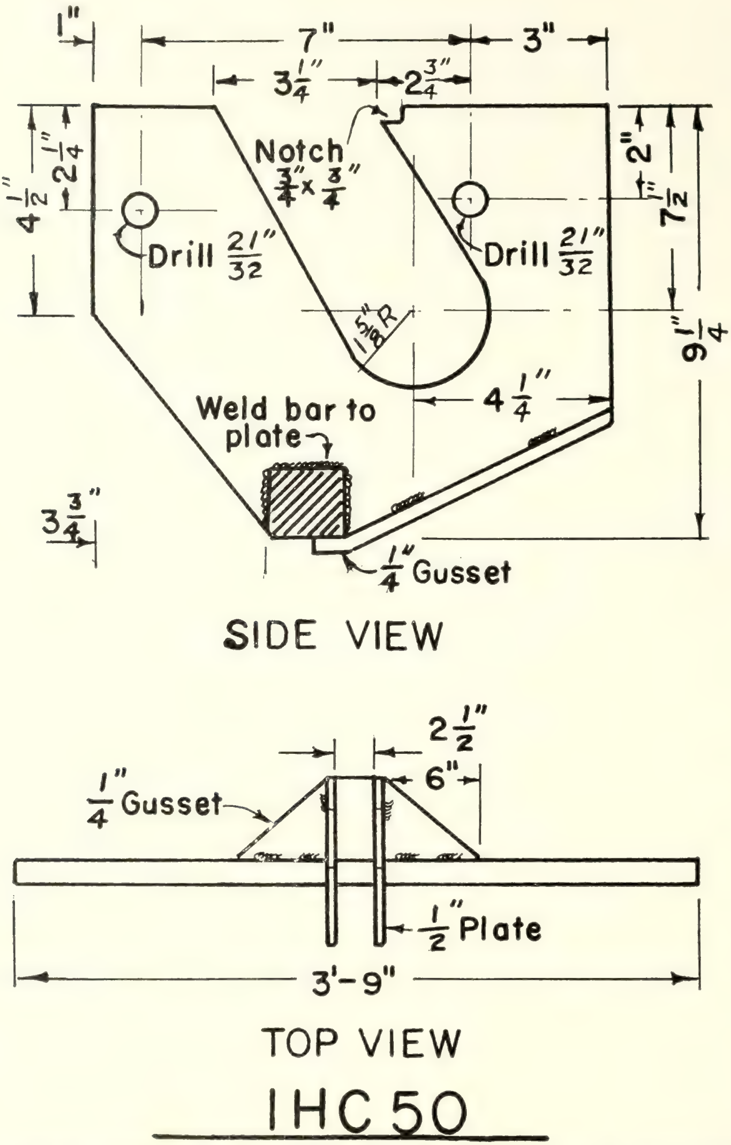

1'- 6"
1 1/8"
2"
5"
Drill 25/32"
2"
1"R
2"
1/2" Plate
45°
4 1/2
1/4" Plate
6 7/8"
4"
3"
1/2"
SIDE VIEW
R & L Req.
9 7/8"
6"
2"
3'-9"
TOP VIEW
CASE M5

Figure 4. Special toolbar for mounting applicator knives on a Case M5 5-row middlebreaker. This toolbar has the gauge wheel standard built on to replace the one on the beam. One lefthand, and 1 righthand bend required. This rig carries 2 bottoms in front of rear tractor wheels and 3 behind.
Note: 2 required per middlebreaker.


1"
7"
3"
$3\frac{1}{4}$"
$2\frac{3}{4}$"
Notch $\frac{3}{4}$" x $\frac{3}{4}$"
$4\frac{1}{2}$"
$2\frac{1}{4}$"
2"
$7\frac{1}{2}$"
Drill $\frac{21}{32}$"
Drill $\frac{21}{32}$"
$9\frac{1}{4}$"
$1\frac{5}{8}$" R
$4\frac{1}{4}$"
Weld bar to plate
$3\frac{3}{4}$"
$\frac{1}{4}$" Gusset
$2\frac{1}{2}$"
6"
$\frac{1}{4}$" Gusset
$\frac{1}{2}$" Plate
3'-9"

SIDE VIEW

TOP VIEW

IHC 50

Figure 5. Special toolbar for mounting applicator knives on an International Harvester model 50 5-row middlebreaker. This model has 4 bottoms ahead of rear wheels and 1 behind.
Note: 2 required per middlebreaker.

makes and models can be made easily.

In the application of anhydrous ammonia, the applicator knives should be offset approximately 6 inches from the center line of the row (Figure 6). Each knife should be set equidistant from the middlebreaker beam to eliminate side draft. Hoses of equal length should be used in connecting the knives to the distributor manifold. If a tank mount is available it may have to be modified to clear the rear-mounted plow when it is in the raised position.

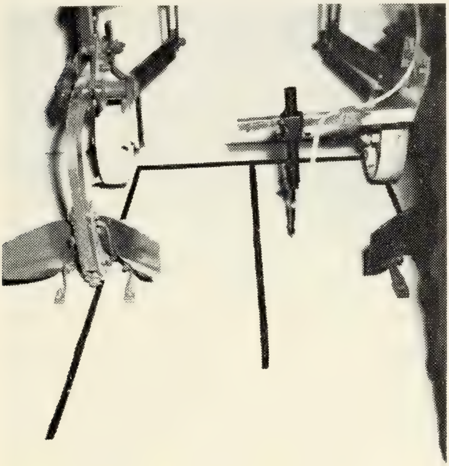


Figure 6. Adjusting middlebreaker bottoms and applicator knives on a line diagram in the shop.

A line diagram is helpful in adjusting equipment of this type (Figure 7). Vertical as well as horizontal settings can be easily accomplished with this diagram It consists of a series of parallel lines on a concrete shop floor or on an open slab. A center line is provided to facilitate placement of the tractor on the diagram and lines to each side represent rows and middles (Figure 8).

The advantages which have resulted from this development include the following: (1) labor and machinery requirements were sharply reduced, (2) elimination of the "guess row" improved the planting efficiency of four-row planters, (3) better coverage was obtained with volatile liquids such as anhydrous ammonia (Figure 9), and (4) easier steering resulted from a balanced arrangement of the equipment load on the tractor.

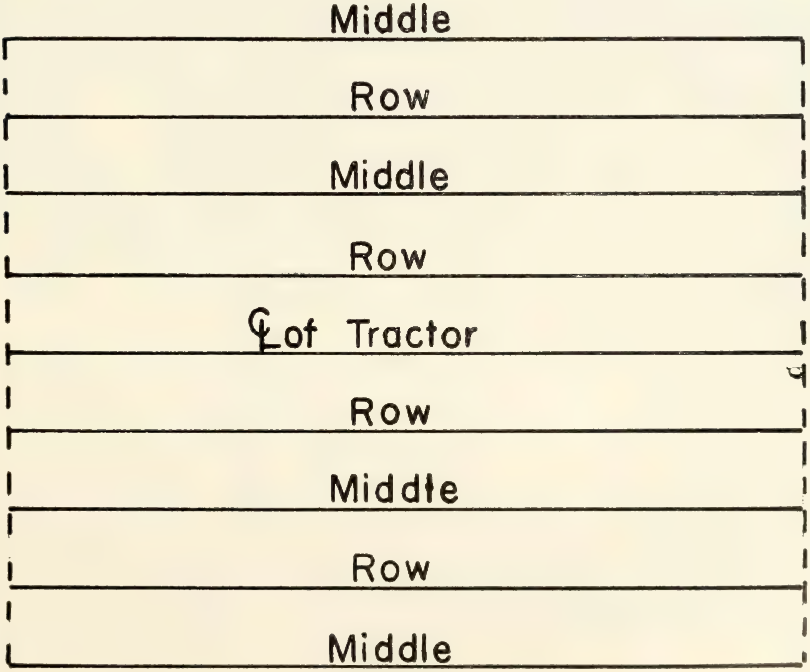


Figure 7. Line diagram for setting farm implements.

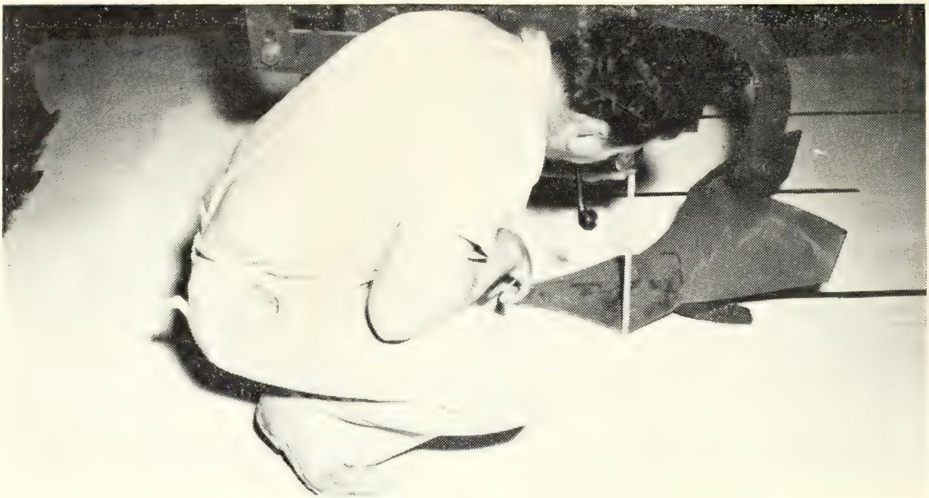


Figure 8. Checking the setting of a middlebreaker on the line diagram.

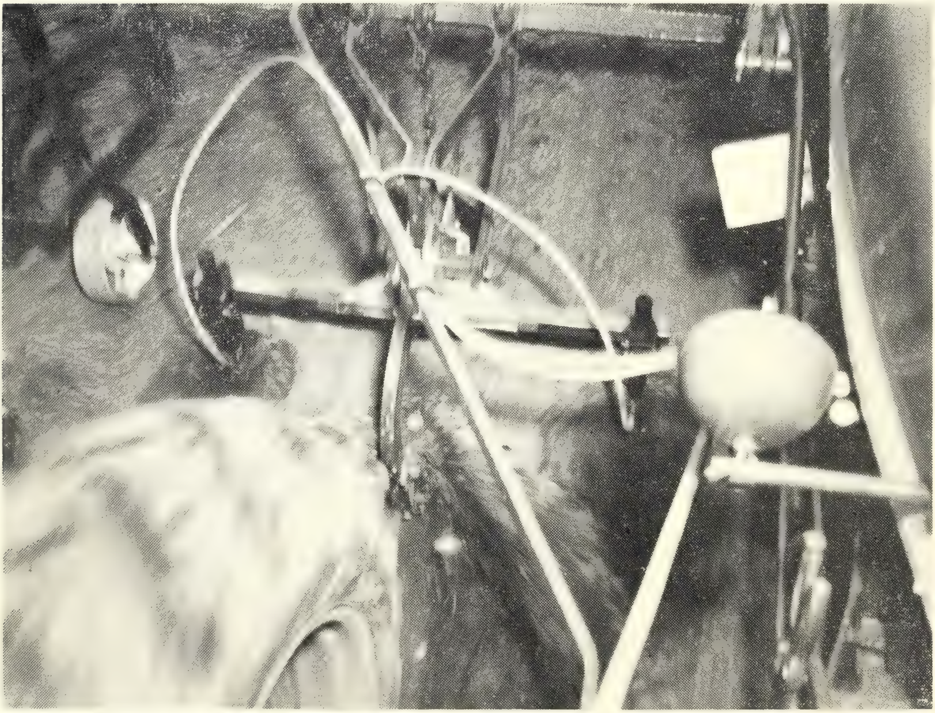


Figure 9. Top view of a front-mounted middlebreaker bottom moving soil in behind two anhydrous ammonia applicators.

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The Study Of
Irrigating Corn In Hill Sections
Of Mississippi

By

E. A. Kimbrough, Jr.
E. F. Ratliff

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

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THE STUDY OF IRRIGATING CORN IN HILL SECTIONS OF MISSISSIPPI

By E. A. KIMBROUGH, JR. and E. F. RATLIFF[1]

Selection of Method

There are several methods of applying irrigation water on hill farms but they may be grouped into two main categories: sprinkler and gravity irrigation. One or several factors may determine how one may best irrigate his land. Factors to consider are:

Field Adaptability: The topography of a field determines in many cases the method of irrigation. Hill land with high percent slopes requires a sprinkler system. Fields with cross slopes from 2 to 3 percent with rows running practically on the contour with 0.2 to 0.3 feet fall per 100 feet have been irrigated successfully by the gravity method. The sprinkler method, of course, could have been employed. The feasibility of land forming should be studied as land-formed fields increase the efficiency of drainage as well as irrigation.

Position of Fields in Relation to Water Sources: Due to the high cost of wells in most of the hill sections, surface reservoirs will be considered as the water source in the methods mentioned.

Hill land above the water source requires mechanical energy to pump the water to the desired elevation. If a sprinkler system is to be used, additional energy is required to provide the pressure.

If there is bottom between the water supply and the land to be irrigated, a continuous pipe system must be used to convey the water from the reservoir to the field. After reaching the field, a gravity or sprinkler system may be used.

If the water supply is at a higher elevation than the fields, the following methods may be used:

(1) A system of control at the water supply to allow flow by gravity through a natural conveyance such as a drainage ditch. The water can be lifted from the ditch by a low pressure pump to irrigate land adjacent to the ditch by the gravity method. This system can be modified by check-damming the ditch and installing a portable pressure system at intervals along it.

(2) A continuous pipe circuit, permanent or portable, that will use the pressure head due to the elevation of the water in the surface reservoir.

(3) A continuous pipe pressure system.

To compare the merits of each method, the following factors can be studied:

What improvements are necessary on the natural drainage ditch?

What improvements on the fields, such as land forming, are necessary before using a gravity system?

Is the water supply located where a gravity system can be used with a minimum of development expenditure?

A gravity system will decrease the pipe inventory required because the pressure sprinkler lateral lines are not needed.

In a sprinkler system, a pump should be used that is capable of delivering at least 60 psi more than is required for a gravity system, and with the same amount of water.

Available Labor: Both furrow and sprinkler systems have been used on the corn tests at State College. The furrow method, a type of gravity irrigation, is the most common method in this category. Gated pipe was employed in the

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[1] Assistant Agricultural Engineer, Mississippi Agricultural Experiment Station.

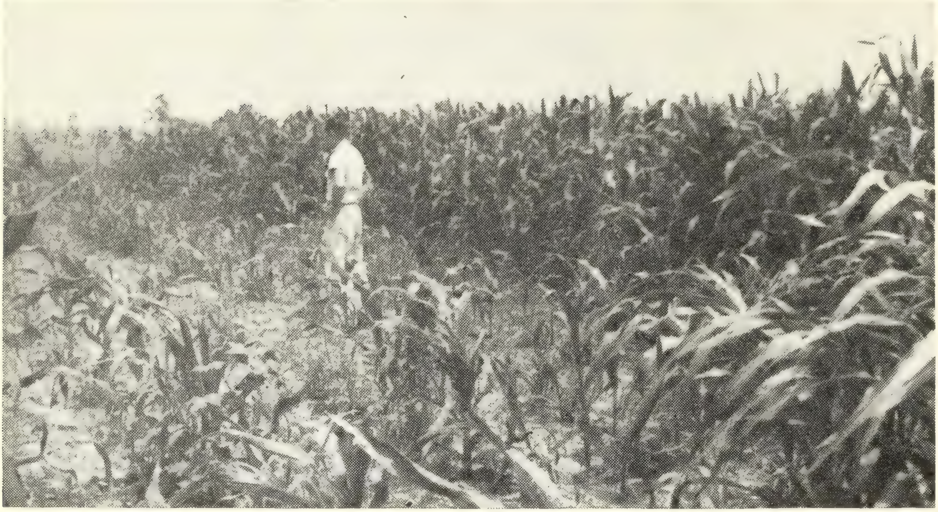

Figure 1. Effect of irrigation on corn during an extreme drought. (Foreground not irrigated, background irrigated).

furrow system.

Applying water with gated pipe requires less labor than the sprinkler system. This is due to a number of reasons. There are no sprinkler laterals to be set up and moved with furrow irrigation. Labor usually works on dry soil when using the gated pipe system, but must go into muddy fields to move laterals after sprinkler irrigating. Pipe trailers can be pulled to the gated pipe for loading and unloading. Labor and equipment required for late irrigations do not usually increase with furrow irrigation. Late irrigations using the spinkler system require long risers and tripods to support the nozzles above the corn. Additional labor is necessary to install this equipment; lateral pipe handling is more time-consuming due to the taller corn.

Numerous factors should be considered before selecting a system. Each farm will present its own special conditions. The decision should be based on the ability of a system to best meet existing conditions.

Irrigation Tests in the Hill Section

Studies of the value of supplemental irrigation on corn have been made at State College continuously since 1950. The various tests have been divided into the following type of studies:

(1) Response of corn with various rates of nitrogen fertilizer and various plant population with and without irrigation.[2]

(2) Measure of response with varying irrigation schedules.[2]

(3) Date of planting test to determine effect of date of planting on production and irrigation requirements.[2]

(4) Irrigation effects on corn varieties.[3]

Nitrogen rate and population test: In the tests of 1950-52, the plant population ranged from 8,000 plants to 16,000 plants per acre. The nitrogen level ranged from 60 to 240 pounds of nitrogen per acre. It was found that the different rates of nitrogen had a much greater influence on production than the different plant populations. Irrigation should be considered only on well fertilized corn. Table I shows that the returns from poorly fertilized corn are likely to be small.

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[2] Cooperative work with H. V. Jordan, Soil Scientist, ARS, USDA, and Mississippi Agricultural Experiment Station.

[3] Cooperative work with the late Dr. R. C. Eckhardt, Dr. C. O. Grogan, and Dr. C. M. Campbell, Agronomists; and H. V. Jordan, Soil Scientist, ARS, USDA, and Mississippi Agricultural Experiment Station.

The 16,000 plant population with irrigation made a slight increase over the other populations; however, the stalks were smaller and not as strong as in the lower populations. The difference in yields is not in favor of the higher plant population. Results shown in Table 4 of the summary were based on 120 pounds of nitrogen per acre.

Variable Irrigation Schedule: During 1953-54, a variable schedule was compared to a high moisture level schedule, with non-irrigated plots serving as checks, Table 2. The schedule was based on moisture measured by a tensiometer type soil moisture meter. The variable schedule test was irrigated at different levels of soil moisture tension, basically 800 centimeters of water tension at a 24-inch depth. The results were not as favorable as the drought period would indicate. The quantity of water required by the two systems of scheduling was 4.5 inches during 1954.

Irrigation caused a slight increase in yields, but considering the cost of applying water, no gain was obtained. High temperature and low relative humidity may have contributed to the lack of response to irrigation.

The Effect of Date of Planting on Irrigation Requirements: Tests were conducted in 1955-56, on the effect date of planting has on irrigation requirements. Three planting dates and two corn varieties were used. Test areas were planted in April, May and June near the middle of each month. Results are shown in Table 3.

A point to observe is the decreased production with a delay in planting. Good weather conditions such as 1955 would produce a good June crop. However, when hot dry conditions are encountered as in 1956, the June planting, even with irrigation, causes a decrease in yield.

It was observed that more irrigation water was required for a June planting. The June planting of 1956 required 11.4 inches of water as compared to 4.6 inches for April and May plantings; therefore, the earlier planting would decrease the need for irrigation and also provide the conditions for higher yields. The 1955 June planting yielded significantly less than either April or May planting, yet showed no significant difference for irrigation.

Irrigation Effects on Various Hybrids: This test, begun in 1957, is being conducted to determine if any hybrids are particularly responsive to irrigation. Table 3 indicates that there may be a hybrid response. The June, 1956 planting had a significant increase from irrigation, especially with Dixie 18. This hybrid had a 32.0 bushel per acre increase due to irrigation as compared to a 19.6 for Dixie 33. However, even with the lower increase with irrigation, Dixie 33 produced 13.9 bushels per acre more than Dixie 18.

Due to rains in 1957 and 1958, there was no increase in yields from irrigation. In 1959 response of different hybrids approached but did not reach significance. This test will be continued as more information is needed on hybrid response to irrigation.

These results show that yearly returns from supplemental irrigation are erratic. The annual cost of irrigation depends on the system and water source used; therefore, the net gain or loss from irrigation also depends on these factors.

Supplemental irrigation tends to stabilize production. In the nitrogen plant population test (1950-1952), with 120 pounds of nitrogen and 12,000 plants per acre, irrigated plots ranged from 114.3 bushels per acre in 1950 to 85.3 in 1952. This is a range of 29 bushels per acre. There was a range of 51.4 bushels per acre on the non-irrigated plots — 105.1 bushels in 1950 to 53.7 in 1952. It appears that farmers can be assured of more stable production, year after year, if supplemental irrigation is used.

Table I. Effect of nitrogen rates and irrigation average results for 1950-1952, inclusive.

Nitrogen applied Lbs./Ac.	Yield of corn		Increase in yield due to irrigation
	Irrigated Bu./Ac.	Non-irrigated Bu./Ac.	Bu./Ac.
60	67.8	60.4	7.4
120	96.1	76.1	20.0
180	103.8	81.0	22.8
240	108.7	82.6	26.1

Table 2. Irrigation schedule test.

Year	Non-irrigated Bu./Ac.	Irrigated[1] Bu./Ac.	Irrigated[2] Bu./Ac.	Water applied inches
1953	62.7	66.7	75.9	2.7
1954	67.5	75.4	76.5	4.5
Average	65.1	71.1	76.2	----

[1] Variable schedule—basically 800 cm. of water tension at 24 inch depth.

[2] Irrigated at 800 cm. of water tension at 12 inch depth.

Table 3. Effects of date of planting on yields and irrigation requirements.

Planting date	Dixie 18		Dixie 33		Water applied inches
	Non-ir. Bu./Ac.	Irrigated Bu./Ac.	Non-ir. Bu./Ac.	Irrigated Bu./Ac.	
April 19, 1955	125.6	126.9	135.0	138.1	1.5
May 15, 1955	128.6	-------	149.7	-------	-----
June 20, 1955	82.0	96.2	109.1	104.7	1.5
April 20, 1956	70.4	78.1	106.5	102.6	4.6
May 14, 1956	81.0	103.8	96.2	117.0	4.6
June 18, 1956	33.9	65.9	60.2	79.8	11.4

Table 4. Summary of corn irrigation tests conducted at State College.

Year	Gross value per acre[1]		Increase per acre due to irrigation Dollars
	Irrigated Dollars	Non-irrigated Dollars	
1950	175.64	155.30	20.34
1951	157.20	128.00	29.20
1952	138.16	87.21	59.95
1953	113.09	93.42	19.67
1954	109.40	96.53	12.87
April, 1955	177.55	174.60*	2.95
May, 1955[2]	----------	186.53	-------
June, 1955	134.67	128.10*	6.57
April, 1956	116.62	114.17*	2.45
May, 1956	141.90	114.29	27.61
June, 1956	94.04	60.63	33.41
1957	157.13	156.12*	1.01
1958[2]	----------	150.10	-------
1959	138.38	122.75*	15.63

[1] Value calculated on season price, Agricultural Statistics 1958 and Mississippi Agricultural Statistics 1957-1958.

[2] No irrigation needed.

*No significant difference due to irrigation.

Conclusions

Soils of low water-holding capacity will require more frequent applications of water; however, they are considered high in water efficiency as they will give greater response per unit of water applied.

The topography of the field determines the method of irrigation.

A hillside reservoir adjacent to a field but higher in elevation provides the most economical source of irrigation water.

If a field is suited for furrow irrigation, the gated pipe system requires less labor than the sprinkler system.

With irrigation, different nitrogen rates have a greater influence on production than different plant populations. Returns from poorly fertilized corn are likely to be small.

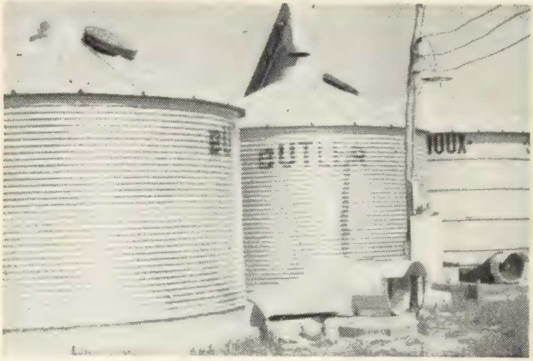
Early plantings of corn are less costly from an irrigation standpoint and normally produce higher yields. Irrigation produces a greater yield increase in the late plantings.

The most beneficial application of water on corn has been at the silking and tasseling period. Water applied after early dent has not given any returns in yields.

Even with a small increase in annual cost of production, irrigation of corn may be beneficial to the farmer in stabilizing production.

BULLETIN 594 MAY, 1960

Cost of On-Farm Drying and Storage of Grain in Mississippi



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ON THE COVER: Inadequate storage facilities reduce the value of Mississippi's grain crop. Lower left, a typical example of delapidated crib; Center, good metal storage bins; Upper right, good storage facilities with drying equipment.

SUMMARY AND CONCLUSIONS

In drying and storing grain, depreciation and interest on investment are the major items of fixed cost. These items account for 95 percent of the fixed cost of batch drying and almost 90 percent of the fixed cost of drying in storage.

Operating cost of a batch-type drier varies widely with the kind of grain dried, the amount of moisture removed and the ambient air temperature at the time of drying. Fuel cost, the major operating cost item for batch drying, varies inversely with the ambient air temperature and directly with the amount of moisture to be removed from the grain.

A comparison of drying cost for batch-type driers of 375-bushel and 500-bushel capacities revealed that total per-bushel drying cost is less for the 500-bushel capacity drier for annual volumes in excess of 15,000 bushels of wheat, grain sorghum, and soybeans; 20,000 bushels of barley and shelled corn; and 25,000 bushels of oats. The more adverse the conditions of drying, the smaller will be the annual volume required to justify the purchase of the larger drier.

Costs of drying grain in metal storage bins vary with drying conditions. Different grains require different air flows and drying times. As the amount of moisture to be removed increases, the time required for drying each grain increases and, when supplemental heat is used, the fuel requirement increases. Also, fuel requirement for drying with heated air increases directly with the relative humidity of the ambient air.

Under ideal conditions, drying in storage with natural air costs less than drying in storage with supplemental heaters. However, conditions in Mississippi normally make it desirable to dry with supplemental heat. Total per-bushel cost of drying in storage with either natural or heated air is lower for the 2,190-bushel bin than for bins of other sizes considered in this study.

No additional investment in storage facilities is required when grain is dried in storage. Storage of grain that has been dried in batch-type driers requires an investment in bins and aeration facilities. The expense of storing grain, whether dried in storage or in batch-type driers, includes interest on inventory value of grain, cost of fumigating for insects, cost of aeration and cost of handling and testing grain.

Grain dried in batch-type driers may be stored more economically in 4,400-bushel bins than in 3,300-bushel bins. The combined cost of drying and storing is lower for storage in the 4,400-bushel bin than in the 3,300-bushel bin if drying is done in either the 375-bushel or the 500-bushel capacity batch-type driers.

For annual volumes in excess of 22,000 bushels the combined drying and storage cost is lower for the 500-bushel capacity batch-type drier than for the 375-bushel capacity model. For annual volumes under 30,800 bushels, the 2,190-bushel bin with supplemental heat provides lower per-bushel cost of drying and storage than can be realized by drying in batch-type driers of either size. Under ideal weather conditions natural air-drying and storage in 2,190-bushel bins is cheapest for all annual volumes considered.

Cost of On-Farm Drying and Storage of Grain in Mississippi

By Frederick H. Read, Jr., Chester M. Wells, Jr. and G. Burns Welch

INTRODUCTION

Grain production has increased importantly as a source of cash farm income in Mississippi in the last two decades. Production of all grains in the state increased from an average of 46.1 million bushels annually in 1935-39 to 70.9 million bushels in 1958. The volume of grain entering marketing channels increased from an annual average of 2.4 million bushels (5% of production) in 1935-39 to 28.5 million bushels (40% of production) in 1958. Income from cash sales of grain averaged less than 2 million dollars annually in the earlier period and totaled over 46 million dollars in 1958.[1]

The marketing problems resulting from the increase in volume of grain marketed have been intensified by changes in farm technology. The more wide-spread use of mechanical harvesters has accelerated the movement of grain to market. Frequently, grain that has moved to market early in the season has contained too much moisture for safe storage.

Efficient marketing of grain cannot be accomplished without adequate facilities for handling the quantity produced, for drying to safe storage levels of moisture content and for protecting quality while in storage. Previous studies[2] have disclosed that commercial elevator facilities are too limited in capacity to handle the volume of grain moving into marketing channels at harvest time and that many of the existing on-farm storage facilities are of such poor quality that grain stored in them is either lost or reduced in value by damage from weather, rodents and insects. For example, only 23 percent of the 64.8 million bushels of weather-proof storage capacity on Mississippi farms in 1958 was rodent proof and only 50 percent could be fumigated. On-farm drying facilities were so few in number that none of the farms in a large sample survey reported any such facilities.

In most recent years, prices received for grain by Mississippi farmers in the immediate post-harvest months have been below the support price. Also, the seasonal advance in grain prices in Mississippi has generally been greater than the national average.[3] These price relationships provide an opportunity for farmers to increase their income by storing grain on the farm. Realization of the potential income from on-farm storage will require the construction of adequate drying and storage facilities that will handle the grain harvest at a minimum total cost. Conditions vary widely from farm to farm, consequently minimum drying and storage cost will require that each facility be designed for the particular conditions found on each farm.

The objectives of the study were to determine the costs[4] of:

(1) drying grain on farms in batch-type driers of two capacities;
(2) drying grain on farms in metal storage bins of three sizes;
(3) on-farm storing of grain in metal bins of selected sizes; and
(4) on-farm drying and storing of grain in alternative combinations of drying and storing facilities.

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[1] Data are from Cooperative Crop and Livestock Reporting Service, Jackson, Mississippi. Rice is not included.

[2] Unpublished data, Department of Agricultural Economics, Mississippi Agricultural Experiment Station.

[3] Unpublished data, Department of Agricultural Economics, Mississippi Agricultural Experiment Station.

[4] The fixed costs reported in this study were those prevailing in 1959 in selected areas of the state. The operating costs were computed for the various grains under specified conditions of drying and storage.

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ECONOMIC CONSIDERATIONS IN DRYING AND STORING GRAIN

Price relationships in recent years suggest a strong probability of additional income from grain storage. Artificial drying prior to storage is not necessary if harvesting is delayed until natural drying occurs. However, earlier harvesting results in an improvement in quality of grain and in the harvesting of more grain. Grain that is harvested earlier must be dried artificially prior to storing.

The conditions that determine the economic feasibility of storing field-dried grain are the cost of storing and the price at harvest relative to the support price and the expected seasonal price increase. For grain that is harvested earlier the cost of drying, including shrinkage loss[5] and adjusted for the increased harvest and improvement in quality, is an additional consideration.

Those producers unwilling to assume the risks associated with storage may choose one of two alternatives: sell grain field-run at harvest or dry grain for sale immediately after harvest.

Grain sold field-run will be discounted for high moisture content if harvested early. Although these discounts can be avoided by delaying harvest until natural field drying has occurred, the loss of grain and depreciation in quality frequently amount to more than the discounts. Also, earlier harvesting usually results in grain being sold before the harvest price-break.

The practicality of drying grain for sale immediately after harvest depends upon the relationships between the cost of drying, including shrinkage loss, and the commercial discounts. At prevailing commercial discounts for moisture,[6] the profitability of drying is greater at higher levels of moisture and at lower prices for grain.[7]

In areas where commercial facilities are adequate, relative costs determine whether commercial or on-farm drying and storage is more profitable. Where commercial facilities are not available, drying and storage can only be done on the farm.

COST OF DRYING IN BATCH-TYPE DRIERS[8]

Batch-type driers are designed to dry grain in relatively small volumes at rapid rates by using large volumes of air at high temperatures. These driers develop air flows up to 75 cubic feet per minute per bushel at temperatures as high as 200 degrees Farenheit. Both stationary and trailer-mounted models powered by either electricity or tractor power take-off are available. Capacities range from 230 bushels to 600 bushels. In this study costs were computed for tractor-powered driers of 375- and 500-bushel capacities.

Fixed Costs[9]

A 375-bushel capacity batch-drier installation requires an investment of $5,913.61—5,125.61 for the drier, $380 for the LP fuel tank and $408 for housing. The investment in the 500-bushel capacity installation totals $6,411.76. The LP fuel tank and housing cost the same as for the 375-bushel capacity installation; the drier costs $5,623.76.

Annual fixed cost is $738.75 for the 375-bushel capacity installation and $804.02 for the larger installation (Table

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[5] See Appendix A, Tables 1 and 2.

[6] See Appendix A, Tables 1 and 2 for representative commercial discount schedules for corn and soybeans. These discounts do not vary with price.

[7] See Appendix A, Tables 1 and 2.

[8] Cost of drying does not include the cost of holding bins, cost of handling and testing grain and shrinkage loss from drying.

[9] Prices of equipment were obtained from manufacturers.

1). Depreciation and interest on investment account for 95 percent of these costs.

Operating Costs

Operating costs vary widely[10] with the kind of grain being dried, the amount of moisture to be removed and the ambient air temperature at the time of drying. Air flow and time required for drying vary importantly with the kind of grain being dried. Drying time and fuel consumption vary directly with the amount of moisture to be removed. Fuel consumption varies inversely with the ambient air temperature at the time of drying.

Total Costs[11]

The total per-bushel cost of drying[12] is highest for wheat and lowest for oats at all annual volumes of drying in both the 375-bushel and the 500-bushel capacity models (Table 2). Drying cost is lower in the 500-bushel capacity model for annual volumes larger than 15,000 bushels of wheat, grain sorghum and soybeans; 20,000 bushels of barley and shelled corn; and 25,000 bushels of oats. Note lines in Table 2. These lines would be at smaller volumes for drying conditions less favorable than those specified in Table 2.

Table 1. Estimated annual fixed cost of batch-type drying in 375- and 500-bushel capacity driers, Mississippi, 1959.

Item	Size of drier	
	375 Bu.	500 Bu.
	Dollars	
Depreciation [1]		
Drier [2]	512.56	562.38
LP fuel tank	19.00	19.00
Housing [3]	20.40	20.40
Total	551.96	601.78
Interest on investment [4]		
Drier and LP tank	137.65	150.09
Housing	10.20	10.20
Total	147.85	160.29
Insurance [5]		
Drier and LP tank	33.59	36.60
Housing	2.49	2.49
Total	36.08	39.09
Taxes on housing [6]	2.86	2.86
Total fixed cost	738.75	804.02

[1] Straight-line depreciation over 10 years for driers, 20 years for LP fuel tanks and housing.

[2] Computed for tractor power take-off models. Electrically powered models would be slightly higher.

[3] Housing for drier estimated at 136 square feet of floor space and cost of housing estimated at $3.00 per square foot of floor space.

[4] Interest on investment computed at 5% of 50% of total investment.

[5] Insurance cost computed at the rate of 61 cents per $100 evaluation.

[6] Assessed value of 17.5 percent of cost and a tax of 40 mills computed by averaging rates reported by tax assessors in the Mississippi Delta and Northeast Mississippi.

COST OF DRYING IN METAL STORAGE BINS[13]

Drying in metal storage bins is accomplished by forcing air through grain. Air flows ranging from 1 to 10 cubic feet per minute per bushel are used. Either natural or heated air is used.

Natural air cannot be used for drying if the relative humidity of the ambient air is excessive (See Appendix B, Table 5). Forcing natural air through grain when the relative humidity is excessive adds moisture to the grain. Although drying will not occur under such conditions, it may be necessary to force air through the grain to prevent damage from heating, particularly for grain of moisture content in excess of that in equilibirum at 90 percent relative humidity.

Use of supplemental heaters makes it possible to dry grain to safe storage levels when the relative humidity is too high for natural-air drying. These heaters are equipped to operate automatically when the relative humidity is too high for natural-air drying. They provide a rise in temperature sufficient to reduce the relative humidity to levels that will permit drying.

Fixed Costs

The total investment required for drying with natural air is $1,101.08 for

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[10] Use the operating manual for the drier to determine costs of drying under different drying conditions.

[11] The cost of maintaining driers was estimated to be 4 percent of other operating costs. Labor requirement were computed on the basis of the hourly capacity of the driers.

[12] These costs would be different for conditions of drying other than those specified in Table 2.

Table 2. Estimated total per bushel cost of drying in driers of two capacities: selected grains under specified drying conditions and for selected annual volumes, Mississippi, 1959.[1]

Grain Initial moisture (%) Final moisture (%) Drying air temperature Ambient air temperature	Wheat 25% 13% 180° 80°	Grain sorghum 25% 12% 180° 80°	Soybeans 20% 11% 120° 80°	Barley 25% 13% 180° 80°	Shelled corn 25% 13% 180° 80°	Oats 25% 13% 180° 80°
Capacity of drier and bushels dried annually			Cents per bushel			
375-bushel capacity						
5,000	19.32	19.21	17.76	18.18	18.61	17.40
10,000	11.93	11.82	10.37	10.79	11.22	10.01
15,000	9.46	9.35	7.90	8.32	8.75	7.54
20,000	8.23	8.12	6.67	7.09	7.52	6.31
25,000	7.50	7.39	5.94	6.36	6.79	5.58
30,000	7.00	6.89	5.44	5.86	6.29	5.08
500-bushel capacity						
5,000	20.21	20.12	18.71	19.19	19.61	18.46
10,000	12.17	12.08	10.67	11.15	11.57	10.42
15,000	9.49	9.40	7.99	8.47	8.89	7.74
20,000	8.14	8.06	6.65	7.13	7.55	6.40
25,000	7.35	7.26	5.85	6.33	6.75	5.60
30,000	6.81	6.72	5.31	5.79	6.21	5.06
35,000	6.43	6.34	4.93	5.41	5.83	4.68
40,000	6.14	6.05	4.64	5.12	5.54	4.38
45,000	5.92	5.83	4.42	4.90	5.32	4.17
50,000	5.74	5.65	4.24	4.72	5.14	3.99

[1] These estimates do not include shrinkage loss and costs of holding bins and equipment for handling and testing grain. Computed at a butane cost of 15 cents per gallon and a wage rate of $1.00 per hour. The cost of maintaining driers was estimated to be 4 percent of other operating costs. Labor requirements were computed on the basis of the hourly capacity of the driers.

the 1,000-bushel bins, $1,899.15 for the 2,200-bushel bin and $2,014.77 for the 2,190-bushel bin (Table 3). The addition of supplemental heaters increases the investment by $453.36 for the 1,000-bushel installation and by $456.93 for each of the larger installations. The total investment for drying with heated air is $1,554.44, $2,356.08 and $2,471.70, respectively, for the 1,000-bushel, 2,200-bushel and 2,190-bushel installation.

Annual fixed cost ranges from $109.73 for drying with natural air in the 1,000-bushel installation to $234.62 for drying with heated air in the 2,190-bushel installation (Table 4). Depreciation and interest account for almost 90 percent of annual fixed cost.

Operating Costs

Different grains require different air flows and drying times. As the amount of moisture to be removed increases, the time required for drying each grain increases and, when supplemental heat is used, the fuel require increases. Also, fuel requirement for drying with heated air increases directly with the relative humidity of the ambient air. These conditions cause the costs of drying in metal storage bins to vary widely.

Total Costs[15]

The total per bushel cost of drying is highest in the 1,000-bushel installation (Table 5). The cost of drying is lower in the 2,190-bushel installation than in the 2,200-bushel installation for each

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[13] Costs of drying were computed for the maximum depths for drying recommended by the Crop Dryer Manufacturers Association. Drying costs would be different for drying at the maximum depths recommended by the United States Department of Agriculture (See Appendix B, Table 1). Cost of drying does not include the cost of handling and testing grain and shrinkage loss from drying.

[14] In-storage drying is not practical in bins larger than the 2,200-bushel installation.

[15] The cost of maintaining drying equipment was estimated to be 4 percent of other operating costs. No charge was made for bin maintenance. Labor requirements were computed on the basis of the hourly capacity of equipment used for loading bins.

of the grains under the conditions specified.

Under favorable drying conditions, drying with natural air is cheaper than drying with supplemental heat. However, drying conditions in Mississippi normally make it desirable to dry with supplemental heat.

Table 3. Estimated investment required for drying grain in metal storage bins of specified sizes with natural air and with heated air, Mississippi, 1959.

Item	Size of bin[1]		
	1,000-bu.	2,200-bu.	2,190-bu.
	Dollars		
Bin and perforated floor	651.84	1,074.12	1,286.34
Erection	101.00	144.00	144.00
Concrete[2]	37.50	60.00	82.50
Reinforcement	9.00	15.20	21.50
Vapor barrier	6.19	9.93	13.93
Total bin	805.53	1,303.25	1,548.27
Fan[3]	245.00	534.50	415.20
Wiring	50.55	61.40	51.30
Total fan	295.55	595.90	466.50
Heater	218.36	221.93	221.93
250 gal. LP gas tank and outlet	235.00	235.00	235.00
Total heater and tank	453.36	456.93	456.93
Total for natural-air drying	1,101.08	1,899.15	2,014.77
Total for drying with supplemental heat	1,554.44	2,356.08	2,471.70

[1] Bin dimensions: 1,000-bushel, diameter 14 feet, height 8 feet;
2,200-bushel, diameter 18 feet, height 11 feet;
2,190-bushel, diameter 21 feet, height 8 feet.

[2] Computed for concrete at $15 per yard.

[3] One and one-half horsepower for 1,000-bushel bin; 5 horsepower for 2,200-bushel bin; 3 horsepower for 2,190-bushel bin. If only soybeans are to be dried or if other grains of very low moisture content are to be dried, a 3 horsepower motor may be used with the 2,200-bushel bin.

Table 4. Estimated annual fixed cost of drying grain in metal storage bins of specified sizes with natural air and with heated air, Mississippi, 1959.

Item	Size of bin and kind of air					
	1,000-bushel		2,200-bushel		2,190-bushel	
	Natural air	Heated air	Natural air	Heated air	Natural air	Heated air
	Dollars					
Depreciation[1]						
Bin	40.28	40.28	65.16	65.16	77.41	77.41
Fan	29.56	29.56	59.59	59.59	46.65	46.65
Heater	—	10.92	—	11.10	—	11.10
LP fuel tank	—	11.75	—	11.75	—	11.75
Total	69.84	92.51	124.75	147.60	124.06	146.91
Interest on investment[2]						
Bins and fans	27.53	27.53	47.48	47.48	50.37	50.37
Heaters and LP fuel tanks	—	11.33	—	11.42	—	11.42
Total	27.53	38.86	47.48	58.90	50.37	61.79
Insurance[2]						
Bins and fans	6.72	6.72	11.58	11.58	12.29	12.29
Heaters and LP fuel tanks	—	2.76	—	2.79	—	2.79
Total	6.72	9.48	11.58	14.37	12.29	15.08
Tax on bins[2]	5.64	5.64	9.12	9.12	10.84	10.84
Total fixed cost	109.73	146.49	192.93	229.99	197.56	234.62

[1] Straight line depreciation over 10 years for fans, heaters and LP fuel tanks; 20 years for bins.

[2] See footnotes, 4, 5 and 6, Table 1.

COST OF STORAGE IN METAL STORAGE BINS[16]

No additional investment in storage facilities is required when grain is dried in storage. Storage of grain that has been dried in batch-type driers requires an investment in bins and aeration facilities. The expense of storing grain, whether dried in storage or in batch-type driers, includes interest on inventory value of grain, costs of fumigating for insects, cost of aeration and cost of handling and testing grain.

Fixed Cost

A 3,300-bushel metal storage bin requires an investment of $1,962.61—$1,646.73 for the bin and aeration ducts, $315.88 for the aeration fan. The investment in a 4,400-bushel bin totals $2,344.64. The aeration fan cost the same as for the 3,300-bushel bin; the bin and aeration ducts cost $2,028.76.

Annual fixed cost is $186.48 for the 3,300-bushel bin and $220.07 for the larger bin (Table 6). Depreciation and interest on investment are the major items of fixed cost.

Table 5. Estimated total per-bushel cost of drying grain in metal storage bins of specified sizes: selected grains under specified conditions of drying, Mississippi, 1959.[1]

Crop	Size of bin		
	1,000 bu.	2,200 bu.	2,190 bu.
	Cents per bushel		
Natural air [2]			
Corn [3]	11.64	9.80	9.63
Wheat [4]	11.61	9.69	9.61
Soybeans [5]	11.55	9.75	9.56
Heated air [6]			
Corn [3]	15.67	12.09	11.69
Wheat [4]	15.64	11.97	11.66

[1] Costs were computed at a wage rate of $1.00 per hour, LP gas 15 cents per gallon and electricity 1 cent per kilowatt-hour. Does not include shrinkage loss and cost of equipment for handling and testing grain.

The cost of maintaining drying equipment was estimated to be 4 percent of other operating costs. No charge was made for bin maintenance. Labor requirements were computed on the basis of the hourly capacity of equipment used for loading bins.

[2] Computed for ideal natural-air drying conditions of 80 degrees Fahrenheit and relative humidity of 70 percent.

[3] Corn with initial moisture content of 25 percent dried to 13 percent at an air flow of 5 CFM per bushel.

[4] Wheat with initial moisture content of 20 percent dried to 13 percent with an air flow of 3 CFM per bushel.

[5] Soybeans with initial moisture content of 18 percent dried to 11 percent at an air flow of 3 CFM per bushel. Drying time of 280 hours taken from publication of Farm Fans Division of Ewing Foundry, Inc., entitled "Your Grain in the Future."

[6] Computed for a temperature rise of 10 degrees Fahrenheit from an ambient air temperature of 80 degrees Fahrenheit at a relative humidity of 70 percent with the supplemental heater operating 75 percent of the time.

Total Cost

Fumigating for insects and aerating to maintain the quality of the grain add 1.01 cents per bushel to the per-bushel fixed cost of storing in both the 3,300- and 4,400-bushel bin. The total per-bushel costs of storing are 6.66 cents for the 3,300-bushel bin and 6.01 cents for the 4,400-bushel bin (Table 6).

Table 6. Estimated annual total and per-bushel costs of storing grain in 3,300-bushel and 4,400-bushel metal bins, Mississippi, 1959.[1]

Item	Size of bin	
	3,300 bu.	4,400 bu.
Annual costs:	Dollars	
Fixed		
Depreciation [2]		
Bin and aeration ducts	82.34	101.44
Aeration fan	31.59	31.59
Total	113.93	133.03
Interest on investment [3]	49.06	58.62
Insurance [3]	11.97	14.30
Tax on bins [3]	11.52	14.12
Total fixed costs	186.48	220.07
Variable		
Fumigants	33.00	44.00
Aeration [4]	.33	.44
Total variable costs	33.33	44.44
Total annual costs	219.81	264.51
	Cents	
Per-bushel costs:		
Fixed costs	5.65	5.00
Variable costs	1.01	1.01
Total per-bushel costs	6.66	6.01

[1] Costs do not include interest on inventory value of stored grain.

[2] Straight line depreciation over 10 years for the aeration fan; 20 years for bin and aeration ducts.

[3] See footnotes 4, 5 and 6, Table 1.

[4] Estimated by assuming grain would be aerated for 3 hours 5 times a year. Electricity cost at 1 cent per killowatt-hour.

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[16] Costs include the cost of handling and testing grain. See Appendix B, Table 7 for costs of equipment for handling and testing grain. Costs do not include interest on the inventory value of stored grains.

Cost of Drying and Storing

The risk of storing grain on farms without facilities for drying is excessive. Consequently, storage in either 3,300-bushel or 4,400-bushel bins is not practical unless facilities are available for drying.

The combined cost of drying and storing is lower for storage in the 4,400-bushel bin than in the 3,300-bushel bin if drying is done in either the 375-bushel or the 500-bushel capacity batch-type driers. For annual volumes in excess of 22,000 bushels the combined drying and storage cost is lower for the 500-bushel capacity batch-type drier than for the 375-bushel capacity model (Table 7). For annual volumes under 30,800 bushels, the 2,190-bushel bin with supplemental heat provides lower per-bushel cost of dryin and storage than can be realized in batch-type driers of either size. Under ideal weather conditions natural-air drying and storage in 2,190-bushel bins is cheapest for all annual volumes considered.

Table 7. Estimated total per-bushel cost of drying and storing grain: selected methods of drying, selected grains and selected annual volumes, Mississippi, 1959.[1]

Bushels dried annually	2,190-bu. bins natural air		2,190-bu. bins supplemental heaters		500-bu. batch-type drier stored in 4,400-bu. bins		375-bu. batch-type drier stored in 4,400-bu. bins	
	Corn	Wheat	Corn	Wheat	Corn	Wheat	Corn	Wheat
				Cents				
4,400	12.80	12.78	14.84	14.81	—	—	29.31	30.02
8,800	11.72	12.70	13.76	13.73	—	—	19.64	20.35
13,200	11.37	11.35	13.41	13.38	—	—	16.42	17.13
17,600	11.19	11.17	13.23	13.20	14.88	14.58	14.81	15.52
22,000	11.08	11.06	13.12	13.09	13.84	14.44	13.84	14.55
26,400	11.01	10.99	13.05	13.02	13.15	13.75	13.20	13.91
30,800	10.96	10.94	13.00	12.97	12.65	13.25	—	—
35,200	10.92	10.90	12.96	12.93	12.28	12.88	—	—
39,600	10.89	10.87	12.93	12.90	11.99	12.59	—	—
44,000	10.86	10.84	—	—	11.76	12.36	—	—
48,500	10.84	10.82	—	—	11.57	12.17	—	—
52,800	10.83	10.81	—	—	11.41	12.01	—	—

[1] Computed for electricity at 1 cent per kilowatt-hour, labor at $1.00 per hour and LP gas at 15 cents per gallon. Includes cost of fumigants and equipment for handling and testing grain.

APPENDIX A

Selected Comparisons of Commercial Discounts and Values of Weight Lost in Drying Corn and Soybeans

Table 1. Corn: Amount of weight lost in drying from selected levels of initial moisture content to 15.5%, value of weight loss at selected prices, and representative commercial price discounts for moisture, Mississippi, 1958.

Initial moisture content	Weight lost in drying to 15.5%	Value of weight lost with corn priced at		Commercial discounts*
		$1.10/bu.	$1.40/bu.	
Percent	Pounds/bu.	Cents/bu.	Cents/bu.	Cents/bu.
15.5	.00	.00	.00	.00
16.0	.33	.64	.82	1.50
16.5	.67	1.31	1.67	3.00
17.0	1.01	1.97	2.52	4.50
17.5	1.35	2.64	3.37	6.00
18.0	1.70	3.33	4.25	8.00
18.5	2.06	4.03	5.15	10.00
19.0	2.41	4.72	6.02	12.00
19.5	2.78	5.44	6.95	14.00
20.0	3.15	6.17	7.87	16.00
20.5	3.52	6.89	8.80	18.00
21.0	3.89	7.62	9.72	20.00
21.5	4.27	8.36	10.67	22.00
22.0	4.66	9.13	11.65	24.00
22.5	5.06	9.91	12.65	26.00
23.0	5.45	10.68	13.62	28.00
23.5	5.85	11.46	14.62	30.00
24.0	6.26	12.26	15.65	32.00
24.5	6.67	13.07	16.67	34.00
25.0	7.09	13.89	17.72	36.00
25.5	7.41	14.52	18.52	38.00
26.0	7.94	15.56	19.85	40.00
26.5	8.18	16.03	20.45	42.00
27.0	8.82	17.28	22.05	44.00
27.5	9.17	17.97	22.92	46.00
28.0	9.72	19.05	24.30	48.00
28.5	10.18	19.95	25.45	50.00
29.0	10.64	20.85	26.60	52.00
29.5	11.12	21.79	27.80	54.00
30.0	11.60	22.73	29.00	56.00

*Discounts made available by Standard Commission Company, Memphis, Tennessee.

Table 2. Soybeans: Amount of weight lost in drying from selected levels of initial moisture content to 13.0%, value of weight loss at selected prices, and representative commercial price discounts for moisture, Mississippi, 1958.

Initial moisture content	Weight lost in drying to 13.0%	Value of weight lost with soybeans priced at		Commercial discounts*
		$2.00/bu.	$2.30/bu.	
Percent	Pounds/bu.	Cents/bu.	Cents/bu.	Cents/bu.
13.0	.00	.00	.00	.00
13.5	.34	1.14	1.31	1.50
14.0	.69	2.32	2.67	3.00
14.5	1.04	3.50	4.02	4.50
15.0	1.39	4.68	5.37	6.00
15.5	1.75	5.89	6.77	7.50
16.0	2.11	7.11	8.16	9.00
16.5	2.48	8.35	9.59	11.50
17.0	2.85	9.60	11.02	14.00
17.5	3.23	10.88	12.50	16.50
18.0	3.61	12.16	13.97	19.00
18.5	4.00	13.48	15.48	21.50
19.0	4.39	14.79	16.98	24.00
19.5	4.78	16.10	18.49	26.50
20.0	5.19	17.49	20.08	29.00
20.5	5.79	19.51	22.40	**
21.0	6.00	20.22	23.22	
21.5	6.42	21.63	24.84	
22.0	6.84	23.05	26.47	
22.5	7.27	24.49	28.13	
23.0	7.70	25.94	29.79	
23.5	8.14	27.43	31.50	
24.0	8.58	28.91	33.20	
24.5	9.04	30.46	34.98	
25.0	9.50	32.01	36.76	
25.5	9.95	33.53	38.50	
26.0	10.41	35.08	40.28	
26.5	10.89	36.69	42.14	
27.0	11.37	38.31	44.00	
27.5	11.85	39.93	45.85	
28.0	12.35	41.61	47.79	
28.5	12.85	43.30	49.72	
29.0	13.36	45.02	51.70	
29.5	13.88	46.77	53.71	
30.0	14.40	48.50	55.72	

*Discounts taken from "Processors Schedule of Discounts" of Commodity Brokerage Company, Memphis, Tennessee.

**Special discounts applied to soybeans containing over 20 percent moisture.

APPENDIX B

Method of Selecting Equipment for Drying and of Estimating Operating Cost of Drying in Metal Storage Bins

The kind of grain, the amount of moisture to be removed and the relative humidity of the ambient air at the time of drying determine the equipment needed for drying and affect the cost of drying.

Selecting the Fan

There are six factors that must be known when selecting a fan for drying grain. These factors are:

1. The kind of grain to be dried. When an installation is to be used for drying more than one type of grain or seed, the selection of the fan should be based upon the most severe drying requirement it will have to meet.

2. The initial moisture content. The moisture content can be determined by testing a sample of the grain with a moisture tester. If there is no tester available, it would be reasonably safe to assume that the grain is at medium moisture content (approximately 20-22%).

3. The depth of the grain. The initial moisture content of the grain will determine the depth to which the drying bin can be filled. The recommended maximum depths for drying grain are given in Table 1.

4. Total quantity of air required in cubic feet per minute. The total quantity of air required is determined by multiplying the number of bushels to be dried by the required cubic feet of air per minute per bushel. The recommended minimum air flow for different moisture contents is given in Table 2.

5. Static pressure. Static pressure is the resistance to the flow of air through the grain and is measured in column inches of water. Table 3 gives the amount of static pressure for grains at different depths and air flows.

6. Performance rating of the fan. This gives the amount of air in cubic feet per minute a fan will deliver against different amounts of static

Table 1. Recommended maximum depths for drying grain in metal storage bins: selected grains at recommended minimum air flows.

Grain	Moisture content of grain, percent									
	16%		18%		20%		25%		30%	
	Feet									
	CDMA	USDA	CDMA	USDA	CDMA	USDA	CDMA	USDA	CDMA	USDA
Barley	8	12	6	10	4	8	*	—	*	—
Shelled corn	—	16	8	12	6	8	5	6	4	—
Wheat	8	10	6	8	4	6	*	—	*	—
Grain sorghum	8	11	6	9	4	7	4	4	*	—
Oats	8	12	—	10	6	8	4	6	*	—
Soybeans	10	16	8	12	6	8	4	6	*	—

Source: Crop Dryer Manufacturers Association, (CDMA) **Grain Drying Recommendation Chart,** Chicago, Illinois, Revised 1956.
U. S. Department of Agriculture, (USDA) Leaflet 332.
* Not recommended.

Table 2. Recommended minimum air flow for drying grain in metal storage bins: selected grains at specified levels of moisture content, dried with either heated or natural air.

Grain	Moisture content of grain, percent				
	16%	18%	20%	25%	30%
	Cubic feet per minute per bushel				
Barley	1	2	3	**	**
Shelled corn	1	2	3	5	6*
Wheat	1	2	3	**	**
Grain sorghum	2	3	4	5*	**
Oats	1.5	—	2	4	**
Soybeans	2	3	4	5*	**

Source: Crop Dryer Manufacturers Association. **Grain Drying Recommendation Chart,** Chicago, Illinois, Revised 1956.
* Heated air only.
** Not recommended.

pressure. This information is available from the fan manufacturer.

Example:[1] What size fan would be needed to dry shelled corn at 25% moisture in a 2,190 bushel bin?

Step 1: The maximum depth recommended by the Crop Dryer Manufacturers Association for drying shelled corn at 25% moisture is 5 feet, (Table 1).

Step 2: A 2,190 bushel bin filled to 5 feet contains 1,368 bushels. The total quantity of air required is 6,840 cubic feet per minute—the required air flow per bushel (5 cubic feet per minute, Table 2) multiplied by 1,368 bushels.

Step 3: Select a fan that will deliver 6,840 cubic feet of air per minute against a static pressure of

Table 3. Resistance of grains to air flow: selected grains at specified air flows.*

Depth of grain in feet	Cubic feet of air flow per bushel						
	1	1.5	2	3	4	5	6
			Barley				
			inches of static pressure				
4	.39	—	.55	.77	—	—	—
6	.60	—	.97	1.45	—	—	—
8	.85	—	1.61	2.65	—	—	—
10	1.25	—	2.55	4.25	—	—	—
12	1.80	—	3.85	6.61	—	—	—
			Shelled-corn				
			inches of static pressure				
4	.32	—	.40	.51	.61	.77	.97
6	.42	—	.64	.97	1.28	1.69	1.45
8	.55	—	.85	1.69	2.30	3.29	2.17
10	.77	—	1.55	2.75	4.15	5.50	4.25
12	1.09	—	2.29	3.75	6.20	—	—
14	1.37	—	3.75	4.25	—	—	—
16	1.69	—	4.57	—	—	—	—
			Wheat				
			inches of static pressure				
4	.51	—	.81	1.13	.58	—	—
6	.82	—	1.57	2.29	1.24	—	—
8	1.37	—	2.97	4.25	3.35	—	—
10	1.94	—	4.15	7.25	—	—	—
			Grain sorghum				
			inches of static pressure				
4	.49	—	.73	1.01	1.21	1.53	—
6	.75	—	1.33	1.87	2.27	3.61	—
8	1.30	—	2.33	3.45	4.21	6.49	—
10	1.75	—	3.40	6.00	8.25	—	—
12	2.40	—	6.15	8.65	12.30	—	—
			Oats				
			inches of static pressure				
4	.41	.49	.59	.81	1.05	—	—
6	.60	.84	1.09	1.63	2.29	—	—
8	.92	1.37	1.77	2.75	4.25	—	—
10	1.45	2.29	2.75	5.05	7.20	—	—
12	1.61	3.00	4.45	7.21	10.10	—	—
			Soybeans				
			inches of static pressure				
4	.32	—	.37	.44	.53	.65	—
6	.38	—	.55	.71	.97	1.21	—
8	.50	—	.81	1.21	1.77	2.33	—
10	.63	—	1.21	2.05	2.85	2.85	—
12	.85	—	1.75	2.29	4.57	6.01	—
14	.99	—	2.21	3.89	6.55	—	—
16	1.21	—	3.13	5.69	—	—	—

*Computed from Resistance of Grains and Seeds to Airflow. Shedd, C. K., **Agricultural Engineering.** Volume 34, September, 1953.

(Static pressure figures include .25″ for duct loss.)

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[1] See the section, "Successive Filling of Drying Bin," page 18, for an explanation of how a fan of the size selected can be used to dry a 2,190 bushel bin to full depth.

1.23 (Table 3). A 3 horsepower fan would provide a margin of safety for drying under the conditions specified.

Selecting the Bin

Generally, static pressures above 3.00 inches require too much fan horsepower for economical drying. The static pressure of a given volume of grain decreases as the diameter of the drying bin increases because the depth of grain is reduced. The lower static pressure of grain in bins of larger diameter makes it possible to dry with smaller fans. Drying with smaller fans is more economical because both initial and operating costs increase as the size of fan increases.

For example, a 3 horsepower fan can be used for drying in a 2,190 bushel bin (diameter 21 feet, height 8 feet) while a larger fan is needed for drying in a 2,200 bushel bin (diameter 18 feet, height 11 feet). The higher initial cost of 2,190 bushel bin is more than offset by the lower initial and operating costs of the 3 horsepower fan.

Moisture Equilibrium Between Grain and Air

The amount of drying that can be done with natural air is dependent upon the relative humidity of the air. For each moisture content of the grain, there is a corresponding relative humidity at which no moisture will move either to or from the grain. This is known as moisture equilibrium. Grain that is drier than the surrounding air will absorb moisture from the air or if it is wetter than the surrounding air it gives up moisture to the air. This transfer of moisture will continue until the equilibrium moisture content for that particular relative humidity is reached. Operating a fan when the relative humidity is above the moisture equilibrium point. will increase the moisture content of the grain. The moisture content at which grain is in equilibrium with the surrounding air at different relative humidities is given in Table 5. Operating a fan when the relative humidity is above the moisture equilibrium point necessitates the use of a supplementary heater.

Selecting The Supplemental Heater

The size of supplemental heater required is determined, in part, by the desired rise in drying air temperature, which can be computed by use of the formula:[2]

Temperature rise = ambient air relative humidity minus desired relative humidity, divided by five and multiplied by 2.

Example: What temperature rise is necessary to dry grain at a drying air relative humidity of 65 percent when the ambient air relative humidity is 90 percent?

$$\text{Temperature rise} = \frac{90 - 65}{5} \times 2 = 10 \text{ degrees}$$

The other determinates of the size of supplemental heater required are the total air flow in cubic feet per minute and the temperature of the outside air. The required BTU rating of the supplemental heater may be determined by use of the formula:[3]

BTU required = Total air flow in cubic feet per minute x desired temperature rise x appropriate constant for outside air temperature (Table 4).

Example: What size of supplemental heater is needed to dry grain with a total air flow of 8000 cubic feet per minute with a desired rise in drying air temperature of 10

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[2] It takes approximately a 2 degree temperature rise to get a 5 percent drop in relative humidity. Peterson, G. M., **Effect on Relative Humidity When Air is Heated by Direct Burning L. P. Gas,** Department of Agricultural Engineering, University of Nebraska, 1958. Printed by Aerovent Fan and Equipment, Incorporated. **A Manual of Aerovent Crop Drying System,** Lansing, Michigan, Undated, p. 60.

[3] Aerovent Fan and Equipment, Incorporated, **A Manual of Aerovent Crop Drying Systems,** Lansing, Michigan, Undated, p. 62.

Table 4. Conversion factors for estimating BTU requirements for supplemental heaters at different ambient air temperatures.*

Ambient air temperature	Constant
40°	1.262
50°	1.238
60°	1.214
70°	1.191
80°	1.168
90°	1.147

*Computed from per-hour fuel consumptions at the indicated ambient air temperatures.

Table 5. Moisture content at which grain is in equilibrium with ambient air: selected grains at specified relative humidities at 77° F.*

	Moisture content in percent							Authority
Relative humidity %	15	30	45	60	75	90	100	
Barley	6.0	8.4	10.0	12.1	14.4	19.5	26.8	C & F
Shelled corn	6.4	8.4	10.5	12.9	14.8	19.1	23.8	C & F
Wheat (soft-red winter)	6.3	8.6	10.6	11.9	14.6	19.7	25.6	C & F
Grain sorghum	6.4	8.6	10.5	12.0	15.2	18.8	21.9	C & F
Oats	5.7	8.0	9.6	11.8	13.8	18.5	24.1	C & F
Soybeans	—	6.2	7.4	9.7	13.2	—	—	R & G

*For example, barley at 12.1 percent moisture will neither gain nor lose moisture if air at 60 percent relative humidity is forced through it.

Source: (C & F) Coleman & Fellows. **Hygroscopic Moisture in Cereal Grains,** Cereal Chem. Volume II, Page 275-287, September, 1925.

(R & G) Ramstad & Geddes. **The Respiration and Storage Behavior of Soybeans.** University of Minnesota, Tech. Bul., June, 1942

degrees when outside air temperature is 40 degrees?

BTU required = 8000 CFM x 10° x 1.262 = 100,960

A heater of this size ordinarily would satisfy minimum requirements for drying in Mississippi because it is not likely that drying conditions will be so adverse that an air flow in excess of 8000 cubic feet per minute will be required for drying in bins as large as the 2,190 bushel bin. Also it is not likely that drying will have to be done at outside air temperature lower than 40 degrees. A heater that will provide a 10-degree rise in temperature will permit drying to safe storage levels with relative humidity as high as 90 percent.

A heater larger than one that satisfies minimum requirements provides a margin of safety with little additional investment. Larger heaters cost only silghtly more than smaller ones and permit drying under conditions more adverse than those specified in the example.

Hourly cost of operating increases as size of heater increases because larger heaters consume more fuel. The number of hours of heater and fan operation is reduced, however, because drying is more rapid with the larger heater.

Estimating Cost of Drying

Estimating LP gas consumption for supplemental heaters. Divide the per-hour BTU rating of the supplemental heater by 88,156 BTU[4] to estimate per hour fuel consumption

Example: Fuel consumption per hour of a 150,000 BTU

$$\text{heater} = \frac{150{,}000}{88{,}156} = 1.7 \text{ gallons}$$

Estimating electricity consumption. Estimate electricity consumption by figuring one kilowatthour per motor horsepower per hour of operation.

Estimating operating cost. Fuel and electricity are the major operating cost items of drying in storage. These costs vary directly with the time required for drying (Table 6).[5] Determine the total fuel and electricity cost by multiplying the per-hour consumption by the estimated time required for drying.

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[4] Butane gas burned at a heater efficiency of 85 percent.

[5] Few data are available on time required for drying. Time required for drying under conditions other than those specified in Table 6 is not known. The time required for drying will be less than that shown in Table 6 for drying when the increase in temperature is greater than 10 degrees.

Successive Filling of Drying Bin

As the moisture content of grain is reduced, the depth at which the grain can be dried increases. In order to obtain maximum use of the drying fan more grain can be added to the bin as drying progresses.

The 2,190-bushel bin equipped with a 3 horsepower fan should be filled by the multiple loading system when corn and soybeans exceed 18 percent moisture content and when barley, wheat, grain sorghum and oats exceed 16 percent moisture content.

For example, shelled corn containing 25 percent moisture will require 5 cubic feet per minute per bushel air flow and may be dried at a depth of 5 feet (Tables 1 and 2). Dry this first filling of grain to 20 percent moisture and then fill bin to a depth of 6 feet with 20 percent moisture grain. The air flow requirement for the 20 percent moisture corn will be 3 cubic feet per minute per bushel. When the grain has dried to 18 percent moisture, fill the bin to a depth of 8 feet with 18 percent moisture grain, air flow requirements will then be 2 cubic feet per minute per bushel. If the initial moisture content of the corn is 18 percent the first fill may be to a depth of 8 feet.

Table 6. Estimated time required for drying grain in storage bins: selected grains at specified outside air conditions and specified temperature increases of the drying air.

Outside air conditions		Temperature rise above outside air temperature			
		None		10°	
Temperature	Relative humidity	Wheat [1]	Shelled corn [2]	Wheat [1]	Shelled corn [2]
		Time in Hours			
90	90	*	*	218	226
90	70	283	294	123	128
90	50	142	147	87	90
80	90	*	*	278	288
80	70	315	330	142	147
80	50	157	163	98	101
70	90	*	*	283	294
70	70	354	368	157	163
70	50	183	190	111	115
60	90	*	*	298	310
60	70	436	452	177	184
60	50	218	226	129	134
50	90	*	*	315	327
50	70	566	588	218	226
50	50	257	268	157	163

Source: J. R. Mayner and Companny, Crop Drying Comparison Chart, Mansfield, Ohio, Undated.

[1] Wheat containing 20 percent moisture dried to 13 percent with an air flow of 3 cubic feet per minute per bushel at a depth of 8 feet.

[2] Corn containing 20 percent moisture dried to 13 percent with an air flow of 5 cubic feet per minute per bushel at a depth of 8 feet.

*Cannot dry grain to safe storage moisture content at this temperature and relative humidity.

Table 7. Estimated cost of equipment for handling and testing grain for metal bins of specified sizes.

	Size of bin	
Item	2,200-bushel 3,300-bushel 4,400-bushel	2,190-bushel
Moisture tester	$105.00	$105.00
Grain sampling probe	35.00	35.00
Portable auger	711.40	580.40
Total cost	$851.40	$720.40

APPENDIX C

Method of Computing Weight Lost in Drying

DRY MATTER PER BUSHEL OF DIFFERENT GRAINS

Shelled corn	47.32 lbs.
Oats	27.40 lbs.
Grain sorghum	47.32 lbs.
Soybeans	51.60 lbs.
Wheat	51.60 lbs.

How to figure the pounds of grain necessary to make a bushel at any moisture content.

Divide the pounds of dry matter per bushel by (100 minus moisture percent of grain).

EXAMPLE: What is the weight of a bushel of corn at 13 percent moisture?

$$47.32 \div (100 - 13\%) =$$

$$47.32 \div .87 = 54.39 \text{ lbs. per bushel.}$$

How to compute the weight of grain after drying from a high moisture content to a lower moisture content.

$$\text{Final weight} = \text{Initial weight} \times \frac{100 - \text{initial \% moisture}}{100 - \text{final \% moisture}}$$

EXAMPLE: 15,000 pounds of grain with a 20% moisture content is dried to 14 percent moisture. The final weight will be:

$$\text{Final weight} = 15{,}000 \times \frac{100 - 20\%}{100 - 14=}$$

$$= 15{,}000 \times \frac{.80}{.86} = 15{,}000 \times .93$$

$$= 13{,}950 \text{ lbs.}$$

Amount of water removed by drying would be:

$$15{,}000 - 13{,}950 = 1{,}050 \text{ lbs.}$$

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Bulletin 595 May 1960

Production Practices, Costs and Returns for Major Enterprises on Rice Farms in The Delta Area of Mississippi

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U. S. Department of Agriculture

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Cover photo:
Seeding rice from the air in flooded field

Production Practices and Costs and Returns For Major Enterprises on Rice Farms in the Delta Area of Mississippi

By TROY MULLINS*

Modern rice farming was extended to the Mississippi Delta immediately following World War II. In the absence of acreage controls, production expanded rapidly. The acreage grown in 10 Delta counties in Mississippi increased from 7,000 acres in 1949 to 69,000 in 1954. In 1959, about 360 farmers in these counties had rice allotments totaling about 45,000 acres.

This new component of Delta agriculture has emerged as a substantial source of income for the area. Also, it has imposed major adjustments on the farms involved.

Rice production requires heavy capital investment in specialized farming equipment, in irrigation wells and water distribution systems, and in drying and storage facilities. Approximately one-third of the total cost of growing rice is attributable to interest, depreciation, and overhead.

At the outset, the cultural practices used in growing rice on the heavy clay soils of the Mississippi Delta were largely on a trial and error basis. Although these soils produce at high levels when well managed, they entail considerable risk in the establishment of stands, in effective grass and weed control, and in harvesting the grain. To cope with these problems, farmers are using various methods of land preparation and seeding, and different rotation systems involving rice and other crops.

SCOPE AND METHOD OF STUDY

This report is concerned primarily with those characteristics of rice farms that are important in determining the economics of resource uses and adjustments. Compared with other farms in the Delta, rice farms are somewhat distinctive in kinds of resources used, average size of units, amounts of capital required, rotation systems followed and in many of the cultural practices associated with the growing of rice. In general, these features of rice farming in the Delta have not been adequately described and evaluated, although much interest in rice farming has been generated in recent years.

In this report, particular attention is given to summarizing the field operations used in growing rice; the usual quantities of materials, man labor, and machinery time used on rice; and the costs and returns for rice and other enterprises commonly found on rice farms. The information should be of interest to farmers, agricultural workers, and others who may be concerned with adjustments in the agriculture of the Delta.

The area of study consisted of Washington, Bolivar, Leflore, and Sunflower Counties, which together account for 80 percent of the total rice production in Mississippi, (fig. 1). A listing of all rice farms was compiled from the records of the local ASC offices, and from this listing a sample of about 100 farms was drawn. To minimize the influence of cotton on the farm organizations to be studied, farms having the highest ratio of rice to cotton (based on allotments) were selected as sample farms for study. The operators of 77 of these farms supplied the information for making the analysis reported here.

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DESCRIPTION OF FARMS STUDIED

On the average, rice farms are larger than cotton farms, and are somewhat less diversified. The nature of the heavy clay soils on which rice is grown, and the marked differences in practices used in growing rice compared with row crops, probably explains these differences.

Sixty percent of the farmers included in the survey had never grown rice before planting it for the first time on their present farms. Of the farmers who had grown rice before, a third had obtained their experience elsewhere in Mississippi, a third in Arkansas, and the remaining third in Texas and Louisiana.

Size of Units

Thirty-one of the 77 farms included in the survey grew less than 150 acres of rice in 1958; these were classed as small rice farms. These farms averaged 716 acres per farm, of which 591 acres was cropland. the remaining 46 farms in the survey each grew more than 150 acres of rice. The average size of these large rice farms was about 1,200 acres, of which 1,000 acres was cropland.

Tenure of Operators

About half the operators of small farms were full-owners, 30 percent were part-owners, and 20 percent were renters. Cash rent was the most common form of rental payment. Thirty-seven percent of the operators of the large farms were full-owners, 43 percent were part-owners, and 20 percent were renters. Slightly over half of the renter-operators of large farms gave a share of the crop in payment for the land they operated.

Kinds of Soil

The soils on the sample farms were predominantly of the heavy clay series. About a third of the 77 farms had clay soils only. Twenty percent included some loam or medium textured soils but had predominantly heavy clay soils. On the remaining 45 percent of the farms, there were some light textured soils, usually comprising less than 10 percent of the cropland.

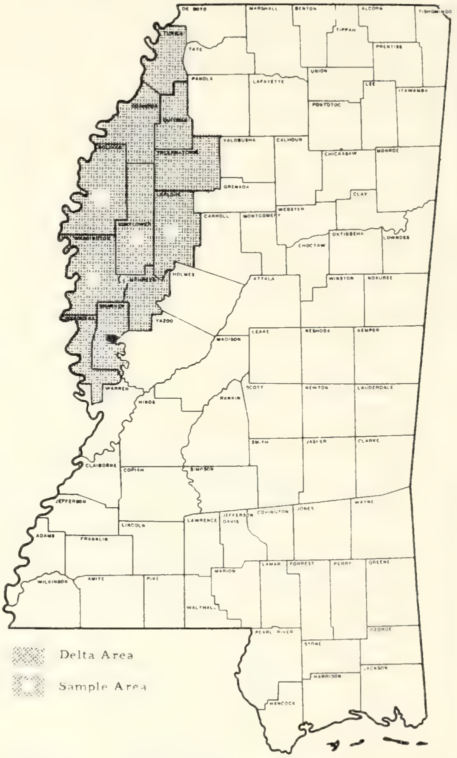
De Soto
Marshall
Benton
Tippah
Alcorn
Tishomingo
Prentiss
Tate
Panola
Lafayette
Union
Lee
Itawamba
Pontotoc
Yalobusha
Calhoun
Chickasaw
Monroe
Grenada
Clay
Carroll
Montgomery
Webster
Oktibbeha
Lowndes
Choctaw
Holmes
Attala
Winston
Noxubee
Yazoo
Leake
Neshoba
Kemper
Madison
Warren
Scott
Newton
Lauderdale
Hinds
Rankin
Smith
Jasper
Clarke
Claiborne
Copiah
Simpson
Jefferson
Wayne
Lincoln
Lawrence
Jefferson Davis
Covington
Jones
Adams
Franklin
Lamar
Forrest
Perry
Greene
Wilkinson
Amite
Pike
Marion
Walthall
Pearl River
George
Stone
Jackson
Harrison
Hancock
Delta Area
Sample Area

Figure 1. Area of study includes Bolivar, Leflore, Sunflower, and Washington Counties. Information reported is applicable to farms on the heavy clay soils throughout the Delta.

The operators of the small farms estimated that 63 percent of their cropland was on heavy clay soils, and 25 percent on medium textured soils. On the large farms, 81 percent of the cropland was on heavy clay soils, and 16 percent on medium textured soils.

Cropping Programs

The kinds of soils on the farms generally determine whether cotton is included in the rotation program, and are a factor in determining the amount of soybeans grown. To reflect differences in cropping plans, the farms were divided into two groups, "rice-cotton" farms and "rice-other crops" farms (table 1). Of the 31 small farms, 20 were rice-cotton farms, growing both rice and cotton along with other crops, and 11 were rice-other crops farms, growing rice and other crops, but no cotton. Of the 46 large farms, 20 were in the rice-cotton group and 26 in the rice-other crops group.

Cropland Use

The 20 small rice-cotton farms averaged 710 acres of cropland per farm, compared with only 374 acres for small rice-other crop farms. With the exception of cotton the crops grown on the small farms were about the same for both the rice-cotton and the rice other crops farms (table 1). An average of slightly over 90 acres of rice was grown on each group of farms. A somewhat larger percentage of the cropland on the rice-cotton farms was devoted to soybeans, but the percentage of the cropland devoted to crops other than rice, cotton, and soybeans was larger for the rice-other crops farms. This is due largely to wheat, which is usually grown on heavy soils. The amount of land "blank farmed" or fallowed averaged 76 acres for the rice-other crops farms and 63 acres for the rice-cotton farms.

With only minor exceptions, the cropland distribution on the large rice farms (those with 150 acres or more of rice) was about the same as for the small rice farms. Both the rice-other crops and rice-cotton farms grew an average of about 315 acres of rice, which amounted to 39 percent and 26 percent, respectively, of the cropland. The comparatively high ratio of rice to all cropland on the rice-other crops farms is largely attributable to the fact that about a third of the operators of these farms were renters. In several instances they controlled only the land that was in crops or fallowed. In their long-term rotation programs they probably use additional land that is not under their control during years it is not used for rice production.

The amount of fallowed land usually is related to acreage of rice farmed. An average of 151 acres were fallowed on all of the rice-other crops farms in the survey, and 171 acres on the rice-cotton farms.

INVESTMENT CAPITAL REQUIRED FOR RICE FARMING

Capital requirements are high for rice farming compared with other types of crop farming. This is particularly true of rice farms in the Delta, where only heavy duty tractors and tillage equipment will effectively perform land tillage operations in the heavy clay soils.

Table 1. Distribution of cropland, by size of farm and cropping program, rice farms, Delta area of Mississippi, 1958.

Items	Small farms		Large farms	
	Rice - other crops	Rice - cotton	Rice - other crops	Rice - cotton
Farms reporting:	Number	Number	Number	Number
Rice	11	20	26	20
Soybeans	8	19	19	19
Cotton	—	20	—	20
Other crops [1]	5	8	7	10
Fallow	9	14	15	16
Average per farm reporting:	Acres	Acres	Acres	Acres
Rice	93	91	315	317
Soybeans	152	294	245	360
Cotton	—	152	—	169
Other crops	88	107	126	187
Fallow	92	90	262	214
Proportion of cropland in: [2]	Percent	Percent	Percent	Percent
Rice	25	13	39	26
Soybeans	30	39	22	28
Cotton	—	22	—	14
Other crops	11	6	4	8
Fallow	20	9	19	14

[1] Wheat was reported on 12 farms; oats on 8 farms; grain sorghum on 10 farms; corn on 3 farms; and hay crops on 3 farms.

[2] Percentages apply to farms reporting the various crops and do not add to 100.

Farm Machinery

The investment in farm machinery, irrigation wells, and buildings was summarized for a sample of the farms included in the survey. Based on the usual number of machines reported and on new value at 1958 prices, the investment in machinery for small farms with 90 acres of rice and about 230 acres of other crops averaged about $40,000, (table 2). This equipment inventory includes a combine for harvesting, and one unit of row-crop equipment for planting and cultivating soybeans (appendix tables 1 and 2). All of the items in the inventory are essential for effective operation. Some operators of small farms owned additional equipment, such as more tractors, extra trucks or pickups, land leveling equipment, or elevators for use in storing grain. Also, some owned relift pumps and motors used to supply water to areas of their farms that could not be reached by gravity flow from their wells. For operators owning any of these additional items the investment in equipment probably would exceed $40,000.

The investment in machinery on typical large farms averaged about $75,000. This is based on new value at 1958 prices and the items commonly used in farming about 300 acres of rice and the other crops grown on farms with 820 acres of cropland. Although cotton is grown on half or more of the large farms, no items of equipment that would be used exclusively for cotton were included in the inventory.

The per acre investment in farm machinery is not as high on large as on small farms. The ratio of number of tractors and basic tillage machines to acres of cropland was smaller for the large farms, but this advantage was off-set in part by larger numbers of machines used for specific jobs or services. These items include portable motors, grain elevators, land forming equipment, and machines used for service and repair of the regular farm equipment. The inventory for large farms includes shop equipment valued at $6,000.

Irrigation Facilities

Other major capital investment on rice farms is in irrigation systems and farm storage and service buildings.

Table 2. Estimated capital investment and annual overhead costs for small and large rice farms, Delta area of Mississippi, 1958.

	Small farms	Large farms
	Dollars	Dollars
Capital invested in:[1]		
Buildings	5,540	10,675
Wells	5,500	15,500
Farm machinery	39,830	75,445
Total	50,870	101,620
Annual overhead costs		
Cash costs:		
Repairs on buildings	178	400
Insurance on buildings and machinery	365	1,057
Taxes[2]	509	1,116
Sub-total	1,052	2,573
Non-cash costs:		
Depreciation		
Buildings	277	534
Wells	433	1,299
Machinery	3,609	7,667
Interest[3]		
Wells	165	495
Machinery	1,195	2,263
Sub-total	5,679	12,258
Total annual overhead costs	6,731	14,831
Annual overhead cost per acre of cropland[4]	21	18

[1] Value of land not included. Other items included and estimated costs are shown in Appendix Table 1. Farm machinery items were on new value at 1958 prices.

[2] Based on rate of 50 mills on assessment of 20 percent of the estimated valuation.

[3] Interest computed at 6 percent on average investment.

[4] Acres of cropland averaged 320 acres for small farms, and 820 acres for large farms.

Irrigation wells are fairly standard between farms. The investment in wells and pumps per acre of rice served is about the same for large and small farms. For the survey farms, investment per well averaged about $5,500. Most small farms were equipped with one well compared with three on large farms.

Farm Service Buildings

Most of the operators of farms in the survey group maintained farm shops and buildings for storage of farm equipment and grain. The investment in buildings used for these purposes averaged about $5,500 on small farms, and about $11,000 on large farms. Grain storage space on the large farms averaged about 20,000 bushels, compared with an average of about 12,000 bushels on small farms. Slightly over 40 percent of the operators of large farms owned stock in commercial dryers in which additional grain could be stored.

Annual Capital Investment Costs

The direct effects of the high capital requirements for farm machinery and the necessary farm improvements for growing rice are reflected in annual overhead costs per farm. For established farm units, these costs are fixed in relation to time and are not directly related to the amount of use of machinery or farm improvements made during any given year. These costs are summarized in table 2. The cash cost for repairs, insurance, and taxes averaged about $1,000 for the small farms, and about $2,600 for the large farms. In addition, the estimated noncash cost for depreciation and interest on capital invested averaged $6,000 and $12,000 respectively for the small and large rice farms.

The total fixed costs (cash and noncash) were about $21 per acre of cropland for small farms and $18 per acre for large farms. On the basis of the usual distribution of use of the major facilities between rice and other crops, at least 60 percent of the annual fixed costs could be charged to rice. On farms with about a third of the cropland planted to rice, and with about average yields (73 bushels), fixed costs chargeable to rice would average slightly over 50 cents per bushel on small farms and about 45 cents per bushel on large farms.

FARM POWER

Farm power units are basic elements of modern day farming. However, the importance of farm power costs varies among crops and among different resource situations. Rice production on heavy clay soils requires particularly heavy use of power in the form of tractors, pumping units, combines, farm trucks, and motors for special uses. Under normal production situations, the costs of ownership and of use of tractors, pumping units, and combines together comprise approximately half of the total cost of growing rice. Hence, effective balancing of the combined capacity in power units with the total work load is an important factor in obtaining overall efficiency in production.

Cost of Tractor Work

The number of tractors on rice farms is related to the size of the farm, and to the acreage of other crops grown. The number of tractors reported on the small rice farms varied one to six, and averaged four per farm. Cropland per tractor averaged 158 acres, and total crops grown averaged 91 acres per tractor.

The number of tractors on the large rice farms varied from 3 to 15 and averaged 6.2 per farm. A higher percentage of the tractors on large farms were of the 40 horsepower and larger units than was true for small farms. Cropland farmed per tractor averaged 150 acres, and total crops grown averaged 114 per tractor.

As indicated above, the size of tractors on rice farms varies over a wide range. The most common size units on small and large farms range from 31 to 40 horsepower, and the second most common size units range from 21 to 30 horsepower (appendix table 4). On rice farms, the 21 to 30 horsepower units are used largely for row crop cultivation and miscellaneous farm service jobs. The major share of the rice field work on small farms is done with tractors in the 31 to 40 horsepower group—42 percent of the total horsepower capacity reported on small farms was comprised of units in this group. On large farms this size group accounted for 26 percent of the total tractor horsepower. Units in the two larger-size groups of 41 to 50 and 51 to 60 horsepower units were not often reported on small farms, but on large farms they accounted for 45 percent of the total tractor horsepower capacity.

Slightly over 50 percent of the tractors on rice farms used diesel or tractor fuel; the remainder were about equally divided between butane and gasoline burning units. Fuel consumption varied according to the load and size of motor. Average consumption per 10 hours for the 31 to 40 horsepower units ranged from about 17 gallons of diesel fuel when performing medium-load jobs to 25 gallons when performing heavy-load jobs. The range in consumption between heavy-load and medium-load jobs was 22 to 29 gallons for 41 to 50 horsepower units and 27 to 34 gallons for 51 to 60 horsepower units (appendix table 5).

Fuel and lubricants account for 60 percent of the variable costs for operating tractors. The major additional costs are for motor overhaul, miscellaneous repairs, and tires (table 3). The combined cost in 1958 for these items averaged $233 for the 31 to 40 horsepower units, $365 for the 41 to 50 horsepower units, and $388 for the 51 to 60 horsepower units.

The overhead or fixed cost for a tractor depends upon its original cost and its estimated life. Based on an estimated life of 12 years, 1958 depreciation on the survey farms averaged $342 for the 31 to 40 horsepower tractors and $483 for the 51 to 60 horsepower tractors. Interest at 6 percent of the average investment was $123 and $174 respectively for tractors of these sizes. The fixed costs comprised about 43 percent of the total cost of operating tractors.

Based on 850 hours of use a year, the total variable and fixed costs per 10 hours of operation averaged $12.71 for 31 to 40 horsepower tractors, $15.61 for 41 to 50 horsepower tractors, and $18.32 for 51 to 60 horsepower tractors.

Power Costs for Pumping

Sources of Water: In the Delta, wells comprise the principal source of water for irrigating rice, although pumping from streams or lakes is not uncommon. Forty-seven of the farmers in the survey, who grew 64 percent of the total acreage of rice used wells as the main source of water (table 4). On ten other farms that produced an additional 18 percent of the rice acreage, wells supplied about half of the water. Low-lift pumps situated along streams, bayous, and drainage ditches supplemented the wells on these 10 farms, and were the principal source of water on the other 19 farms in the survey. A total of 111 wells and 57 surface pumps were used in irrigating slightly over 17,000 acres of rice, or about 100 acres of rice for each pump installation.

Description of Wells: Irrigation wells in the Delta average about 120 feet in depth. Pumps range in size from 8 to 12 inches; the average is 10 inches. Pump bowl settings are about 40 feet below the surface, and the wells have an average capacity of about 2,000 gallons per minute.[1] Most irrigation wells in the area were drilled during the 3-year period 1952-54, at an average cost of about $5,500. Drilling the well and setting the casings and screen usually costs about $3,000. The pump with gear head usually costs about $1,300, and an electric motor (30 to 40 horsepower) about $1,200. If a fuel burning engine is installed the cost runs about $1,000 more, depending on the size of motor used.[2]

---

[1] The average depth of 146 irrigation wells in Bolivar County is 121 feet (92 are between 100 and 129 feet), and the average capacity is 2,054 gallons per minute. Summarized from Bulletin 564 of Mississippi Board of Water Commissioners.

[2] The total installation cost average $5,548 for 44 wells equipped with electric motors, and $6,838 for 19 wells equipped with fuel engines.

Days Pumped and Seasonal Operating Costs: Water usually is maintained on rice fields for a period of 90 to 130 days. The period varies with varieties and with dates of planting for a given variety. Pumps are not operated continuously for the entire irrigation period, as most fields are "dried down" one or two times each season for the application of fertilizer and for other reasons. Also, pumping is sometimes unnecessary for short periods because of heavy rainfall. For 99 wells and surface pumps, the number of days operated during 1958 was determined from records of the companies that supplied the electricity. These pumps were operated an average of 68 round-the-clock days during the 1958 growing season. The number of days operated was unusually low for some of the wells (6 operated less than 20 days), indicating that the average of 68 days

Table 3. Estimated annual and daily cost of operating tractors of selected sizes, 1958.

Items	Drawbar horsepower rating		
	31 to 40	41 to 50	51 to 60
	Dollars	Dollars	Dollars
Cost items on annual basis			
Variable costs:[1]			
Diesel fuel (heavy work)	345	389	466
Oil and grease	37	41	47
Repairs:			
Motor overhaul	63	102	110
Miscellaneous repairs	77	87	91
Tires[2]	93	176	187
Sub-total	615	795	901
Fixed costs:			
Interest[3]	123	141	174
Depreciation[4]	342	392	483
Sub-total	465	533	657
Total	1,080	1,328	1,558
Cost items on 10 hour basis[5]			
Variable costs:			
Diesel fuel	4.06	4.57	5.48
Oil and grease	.44	.48	.55
Repairs:			
Motor overhaul	.74	1.20	1.29
Miscellaneous repairs	.91	1.02	1.07
Tires	1.09	2.07	2.20
Sub-total	7.24	9.34	10.59
Fixed costs:			
Interest	1.45	1.66	2.05
Depreciation	4.02	4.61	5.68
Sub-total	5.47	6.27	7.73
Total	12.71	15.61	18.32

[1] Quantities of fuel used per 10 hours of operation with medium and heavy loads are shown in Table 9. Diesel fuel figured at 16c per gallon, oil at 85c per gallon, and grease at 20c per pound.

[2] Farmers estimated the life of front tires at 2.5 years, and rear tires at 5 years.

[3] Interest based on 6 percent of average investment. Price of new tractors averaged $4100, $4700, and $5800 for these size groups.

[4] Based on average life of 12 years.
rice farms.

[5] Based on 850 hours of use per year (85 days), as estimated by operations of large rice farms.

Table 4. Number of farms and acres of rice irrigated, by source of water, 1958.

Source of water	Number of farms	Number of pump installations		Rice irrigated		Rice irrigated per pump
		Wells	Surface			
	No.	No.	No.	Acres	Percent	Acres
Wells[1]	47	88	9	11,005	64	113
Wells and surface pumps	10	19	21	3,023	18	76
Surface pumps[2]	19	4	27	3,141	18	101
Total	76	111	57	17,169	100	102

[1] Seven farmers pumped surface water to supplement their wells, but in each case the pumps supplied less than 30 percent of the total water used.

[2] Only three of these farmers used wells, and in each case the wells supplied less than 30 percent of the total water used.

may not be representative for seasons when rainfall is not as abundant as in 1958. Sixty-five wells were operated more than 60 days, and averaged 86 days each.

The amount of water pumped for rice, and consequently the seasonal pumping costs, varies widely among farms. Compared with the older rice areas, comparatively large amounts of water are used on Delta rice fields. Several factors contribute to this. The porous nature of the heavy clay soils, particularly after plowing, permits a large amount of seepage through field levees, border fills, and the walls of head ditches. Also, the standard of levee engineering and construction often are such that waste cannot be avoided. Furthermore, some farmers think that gradual movement of water through their fields benefits the rice by keeping the water fresh and reducing the amount of scum and other undesirable growth.

The variation in seasonal pumping costs on fields that were irrigated entirely from wells is shown in table 5. The average variable or out-of-pocket pumping cost was slightly less than $6 per acre irrigated on 9 farms, $10 per acre on 25 farms, $15 per acre on 9 farms, and slightly over $20 per acre on four farms. For the 47 farmers irrigating from wells, the variable cost averaged $10.73 per acre.

The total costs of irrigating rice from wells when the interest and depreciation on capital invested in the pumping plant are included are shown in table 6. For 71 wells operated with electric motors, total costs averaged slightly less than $15 per acre irrigated. Overhead costs averaged about $4 per acre. Total cost per acre for 17 wells equipped with fuel engines averaged $16.40. The higher costs for these wells were due entirely to higher overhead costs, as the cost of fuel, oil, and repairs was practically the same as the cost of current and repairs for the electrically powered wells.

Cost of Combine Operation

Rice farmers usually own combines for harvesting rice and other crops. Twenty-seven of the 31 operators of small rice farms owned combines. Four of the 27 operators owned 2 combines each; making an average of 1 combine per farm reporting. Forty-five of the 46 operators of large rice farms owned combines; the average was 2.2 per farm reporting. The machines ranged from 10 to 14 feet in width. About three-fourths were 12-foot and one-fifth were 14-foot machines. Detailed operating cost data were obtained for 17 of the 31 combines on small rice farms, and for 64 of the 99 combines on large rice farms (table 7). About two-thirds of the machines on small farms were used to harvest crops for other farmers on a custom or exchange basis, compared with only two-fifths of those on large farms. By doing custom and exchange work, the operators of small farms used their combines for about as many days, and for harvesting about as many acres of all crops, as operators of large farms. Combines on small farms were used an average of 25 days per machine, to harvest an average of 233 acres of all crops. On large farms, machines were used an average of 27 days, to harvest an average of 236 acres. The acreage of rice harvested was slightly higher in relation to other crops on the large than on the small farms.

Table 5. Distribution of farms and acres of of rice irrigated by levels of pumping costs, and average costs per acre, 1958.

Farms*	Acreage irrigated	Pumping costs per well Range	 Average
No.	Acres	Dollars	
9	2,179	7.49 or less	5.87
25	6,347	7.50 to 12.49	9.95
9	1,528	12.50 to 17.49	14.98
4	951	17.50 and over	20.26
47	11,005		10.73

*Includes only farms using wells as primary source of water.

Variable cost for operating combines consist mostly of repairs and gasoline. Repair costs averaged $[illegible]75 per season for all combines, or about $14 per day of operating time. The motors consumed an average of 4 gallons of gasoline per hour at an average cost of $6.60 per day. Service time averaged 2 hours per day; cost of this labor added to the cost of oil and grease amounted to about $3.05 per day. Thus, the total variable costs per combine averaged slightly over $23.00 per day of operating time.

Overhead or fixed costs on combines are of major importance in the total cost of harvesting rice and other crops. The new cost of combines purchased in 1958 averaged $8,735. Operators of small farms estimated the average life of machines to be 9.2 years; operators of large farms estimated the average life to be 7 years. The operators of small farms generally drive their own combines and do much of the repair work, which may explain the difference in estimated life. Annual depreciation based on an estimated useful life of 7 years averaged $1,248 (table 8). Including interest on the average investment, the total overhead or fixed costs averaged $1,510 per year for combines on large farms. This is equal to about $56 per day of operating time each season.

The total variable and fixed costs per season averaged $2,141. This is equal to $10.60 per hour of operation. Based on usual performance rates the machine costs would average $9.54 per acre for harvesting rice, and $5.26 per acre for harvesting other crops.

Tabel 6. Estimated costs of irrigation water for rice, by kind of power used for pumping, 1958.

Item	Kind of power used			
	Fuel engines		Electric motors	
Number of wells	17		71	
Acres of rice per well	112		127	
Seasonal costs	Per well Dollars	Per acre Dollars	Per well Dollars	Per Acre Dollars
Variable items				
Fuel	1,039	9.28	—	—
Electricity	—	—	1,235	9.65
Oil	35	.31	12	.09
Repairs	134	1.20	127	.99
Sub-total	1,208	10.79	1,374	10.73
Overhead items				
Interest [1]	195	1.74	165	1.29
Depreciation [2]	433	3.87	366	2.86
Sub-total	628	5.61	531	4.15
Total	1,836	16.40	1,905	14.88

[1] Computed at 6 percent on average investment of $6500 for wells with fuel engines and $5,500 for wells with electric motors.

[2] Based on estimated life of 15 years for well, pump, and motor.

Table 7. Specified information on combine operations by size of farm, 1958.

Items	Unit	Small farms	Large farms
Combines for which cost data obtained	No.	17	64
Used only on operator's farm	"	6	38
Used on other farms [1]	"	11	26
Used only for harvesting rice	"	3	15
Used for harvesting rice and other crops [2]	"	14	49
Rice harvested per combine:			
Average	Acres	129	141
Range	"	65 to 250	50 to 342
Other crops harvested per combine:			
Average	"	104	95
Range	"	30 to 240	32 to 360
Operation per combine for:			
Rice harvest	Days	15	18
Other	"	10	9
Total	"	25	27

[1] On the small farms about one-third of all crops harvested was for other farmers, mostly on a custom basis. On the large farms only about 15 percent of the total harvested was for other farmers, and only 10 percent was on a custom basis.

[2] Thirteen of the combines on small farms and 42 of those on large farms were used to harvest only soybeans in addition to rice.

PRODUCTION PRACTICES USED IN GROWING RICE

The field practices used by farmers in the Delta area of Mississippi stemmed from practices commonly followed in the older rice areas of the South. However, these have been modified substantially to cope with the heavy clay soils of the Delta. Different types of equipment are used for land preparation, and the seeding methods are more varied.

Field Operations

Information on practices followed in growing rice were obtained from 75 of the 77 farmers included in the survey. Methods of preparing land, particularly the timing of the initial tillage operations, vary with the rotation programs used.

When a relatively short rotation period of 2 or 3 years is used, farmers generally summer fallow about as much land each year as they seed to rice. The fallowed land requires little preparation for seeding the next spring. Rice is not grown on the same fields for two consecutive years. In such rotations, production of secondary crops such as soybeans or small grains is not usual.

Some farmers use rotation periods of 5 to 6 years in which rice is grown two years in succession on the same land, which is then free of rice for periods of 3 to 4 years. This rotation allows more time for growing other crops and for conditioning the land for the next sequence of rice crops, but half or more of the rice each year is seeded on land that grew either rice or other crops the previous season. This limits the land preparation that can be done in the fall, and increases the risks associated with unfavorable spring weather for field operations. The probability of being able to plant at the optimum seeding dates on well prepared seedbeds is thus reduced.

Preplant Land Tillage: On the heavy soils of the Delta, land preparation operations are performed with offset disks, heavy tandem disks, and various types of harrows. The usual sequence is one or two times over with the offset disk, followed after varying time intervals with the tandem disk for three or more times over. Harrows are commonly used following each cutting with the tandem disk or for the final operations prior to planting. Some farmers use land planes or similar leveling devices to improve the surface condition of their fields; this operation is usually performed on only a part of their land each year. For the survey farms, the total man labor and tractor time required for preplant operations averaged about three hours per acre.

Levee Construction: Levees are built immediately after the preplant tillage operations are finished. The levees are usually surveyed and marked, and gone over the initial one or two times with a levee disk prior to seeding. The final two to four times over are done after seeding.

Levees are commonly established on contour, 0.2 to 0.3 feet apart in vertical drop. As the lines of contour are located with the engineer's level they are

Table 8. Cost of owning and operating combines, 1958.[1]

Item	Cost
	Dolllars
Annual average per combine:	
Operating costs	
Gasoline [2]	178.00
Oil [2]	8.00
Greas [2]	16.00
Service labor [3]	54.00
Repairs	375.00
Sub-total	631.00
Fixed or overhead costs:	
Depreciation [4]	1248.00
Interest	262.00
Sub-total	1510.00
Total annual costs	2141.00
Average unit costs:	
Per hour of use	10.60
Per acre of rice harvested	9.54
Per acre of other crops harvested	5.26

[1] Based on operating cost data for 64 combines, mostly 12 ft. widths, which harvested about 9,000 acres of rice (141 acres each) and 6,000 of other crops (91 acres each).

[2] Gasoline consumption averaged 4 gallons per hour, oil 1.5 quarts per day; and grease 3 pounds per day.

[3] Service time averaged 2 man hours per day.

[4] Based on 1958 price of $8,735 per combine and 7 years average life.

marked with a tractor-drawn plow. The levees are raised to the desired height by pulling with a levee disk, from three to six times over for each levee. Some farmers prefer to perform the final operations with a levee "squeeze", which is a V-type drag designed to reduce seepage by packing the heavy soil.

In levee construction, the ends are usually filled or "butted" where each cross levee connects with the border levees. Openings are made in each of the cross levees at regular intervals to allow water passage during the period of germination and until the first flood is applied. For the most part these filling and cutting operations are done with scoops mounted on small tractors. Some hand shoveling is usually necessary to complete the levee building operations.

The complete levee surveying and construction operations require about 1.5 man hours and 1.0 tractor hours per acre.

Seeding Operations: With ground equipment, which is most common in the Delta, rice is seeded after the first levee building operations are performed and before the levees are raised to the desired height. Seeding was done with endgate seeders by slightly over 50 percent of the farmers in the survey, and grain drills were used by the remainder of those using ground equipment. About 20 percent of the farmers seeded some rice in water with planes in 1958, and indications are that this practice was more common in 1959. Water seeding is often used during the later weeks of the planting season when quick germination and effective grass controls are particularly important.

Some farmers reseeded their levees after the final levee-building operations, but this is not the predominant practice.

Labor required for seeding with endgate seeders and covering with harrows averaged about 0.6 hour per acre, and tractor time averaged 0.4 hours per acre.

Watering Practices: Rice is kept flooded for 90 to 120 days during the growing season. The period varies for the different varieties and for different planting dates. The principal function of water cover is to eliminate competitive weeds and grasses that otherwise could not be controlled. It also conditions the soil and provides a favorable environment for growth of the rice. Hence, the application and management of water is a key operation in rice farming.

The first flood is applied as early as possible after the rice seed germinates and a stand is established. Under favorable weather conditions, this may be about two weeks after planting, but if germination is slow three weeks may elapse before the first flooding. Application of the first flood requires close attention to avoid breakage of levees, and to stabilize the water at the desired level. If the levees are accurately located and well constructed, relatively little time is required to apply the first water; otherwise, labor requirements may be much higher. Some farmers applied the first water with one-fourth to one-half hour of labor per acre, whereas others used as much as four hours per acre. The average for all farms was 1.5 hours per acre.

Most fields are drained after three to four weeks under flood, and the soil is allowed to dry for several days. This permits the roots of the rice plants to become more firmly established, and stimulates additional tillering. If glass is well under control, fertilizer may be applied at this time. Closing the levees and tending water while the second flood is applied requires considerable labor, but generally somewhat less than for the first flooding.

During the remainder of the watering period a daily check of the water level between levees, of seepage areas or potential levee breaks, and of the operating condition of the pump and motor, comprise the daily routine.

Most operators of small farms in the survey tended the pumps and checked the levees themselves. These operators irrigated an average of about 87 acres of rice, devoting 4 to 5 hours a day to these jobs.

On the large farms, regular workers are assigned to irrigation of the rice. The irrigation attendants on the survey farms care for an average of 157 acres of rice each. Applying the first and second floods required 2.5 hours. Total additional time required for tending the levees and wells averaged 5.7 hours per acre, making a total of 8.2 hours per acre for the entire watering operation.

Fertilizer Application: On the large farms, 84 percent of rice acreage was fertilized; on the small farms 76 percent was fertilized. Practically all farmers applied nitrogen only, usually in the form of urea. The rate per acre ranged from 45 to 75 pounds of nitrogen, and averaged 58 pounds per acre for the total acreage in the survey farms.

Fertilizer is usually applied with planes just before the second flooding of the fields. However, if the rice is not sufficiently advanced or if the grass is not well under control, the fertilizer treatment may be delayed for a couple of weeks. It is then necessary to drain the field a second time, and reflood after applying the fertilizer.

Farmers usually furnish two flagmen to guide the pilot in applying fertilizer, and one to three men as helpers in loading the plane. Total time required depends upon such factors as size of fields, convenience to the loading station, and amount of material applied. On the survey farms, an average of 200 acres were fertilized for each 10-hour period. With an average crew of 4 men furnished by the operator, only 0.2 hours of labor per acre was required for applying fertilizer.

Weed and Insect Control: Coffee beans and Indigo weeds are prevalent in practically all rice fields in the Delta. Depending upon degree of infestation, they are controlled either by hand pulling or with herbicides applied by hand applicators, tractor sprays, or plane. Eighty-two percent of the total acreage of rice on the farms surveyed was treated with herbicides, mostly applied with tractor-drawn equipment. Most farmers used 2-4D, but some used 2-4-5T or Kuron. One application of herbicides required about 0.4 man hour and 0.3 tractor hour per acre.

Usually it is not necessary to apply insecticides to rice fields, but occasionally stink bugs are present in sufficient numbers to do appreciable damage. Fifteen percent of the acreage in rice was sprayed for stink bugs. Toxaphene and Aldrin were the most commonly used insecticides.

Harvesting Operations: Rice is harvested with self-propelled combines. The time required and the cost of harvesting depend largely upon the weather at harvest time. Heavy rains and wind often cause excessive lodging, and create unfavorable surface conditions for operating combines and other equipment.

The operations involved in harvesting are combining, transferring the grain to trucks, and hauling it to dryers. A typical complement of men and machines includes two combines and drivers; one grain cart, tractor, and driver; two trucks and drivers; and one extra man and stand-by tractor at the field. If the rice is delivered to commercial storage no help at the dryer is furnished by the operator. Operators of small farms often harvest with one combine, but it is a common practice to exchange work with neighbors in order to form crews of two or more combines.

Crews of two combines harvested an average of 16.6 acres per day, operating 7.5 hours a day. This is slightly less than 1 hour of man labor and combine time per acre. Under unfavorable conditions the time may be increased as much as 50 percent; when conditions are favorable the time is appreciably less. In addition to the labor required to operate the combine, the equivalent of two more hours of labor is required to operate the grain cart, to haul the rice to storage, and to service equipment.

Total Labor and Machinery Use

The usual operations performed in growing rice, and the hours of man labor and machinery use are summarized in table 9. About 17 hours of labor is normally used in producing an acre of rice. Slightly more than 5 hours are devoted to land preparation, seeding, and levee forming; about 9 hours are used for watering, weed control, and application of fertilizer; and 3 hours are used in harvesting. Slightly more than 5 hours of tractor time are used per acre. About 4.5 hours of tractor time are required to prepare the land, seed the rice, and construct the levees; less than 1 hour is used in connection with harvesting and weed control measures.

Materials and Services

About half of the total cash expended in the production of rice goes for the purchase of seed, fertilizer, herbicides, and special services such as plane applications and drying. This is in addition to the fuel and lubricants required for tractors and other power units.

The usual seeding rate on farms in the Mississippi Delta is higher than in the older rice areas. On the farms surveyed, it ranged from 2.5 to about 3.5 bushels per acre, and averaged 3.0 bushels. About a fourth of the acreage is reseeded each year. The cost of seed averaged $13.50 per acre.

Fertilizer, herbicides, and insecticides were discussed in the previous section. The cost of these items averaged about $11.00 per acre.

Two kinds of services are hired by most rice farmers. The application of fertilizer and insecticides is generally

Table 9. Usual operations performed and labor and power used per acre for rice production.

Operations	Date performed	Rate per day	Times over	Hours per acre	
				Man	Tractor
		Acres	No.	Hours	Hours
Off-set disk	12/15 to 4/1	17	2	1.2	1.2
Tandem disk	3/10 to 5/20	30	3	1.0	1.0
Harrow	3/10 to 5/20	40	2	.5	.5
Miscellaneous [1]	3/10 to 5/20	—	—	.3	.2
Sub-total				3.0	2.9
Survey and mark levess	4/1 to 5/15	60	1	.5	.2
Seed (grain drill) [2]	4/10 to 6/1	50	1.2	.5	.2
Cover [3]	4/10 to 6/1	50	1.2	.2	.2
Pull levees	4/10 to 6/1	50	3.5	.7	.7
Butt levees (tractor)	4/10 to 6/1	60	1	.3	.2
Sub-total				2.2	1.5
Watering:					
First flood	5/10 to 6/15	—	—	1.5	—
Drain and reflood	6/20 to 7/5	—	—	1.0	—
Daily attendance	5/20 to 9/20	—	—	5.7	—
Fertilizing	7/1 to 8/1	200	1	.2	—
Weed control:					
Tractor	7/1 to 8/1	33	1	.4	.3
Hand	7/1 to 8/1	4	1	(2.5)	—
Sub-total				8.8	.3
Combine [4]	9/15 to 11/1	11	1	.9	—
Cart to truck		11	1	.6	.6
Haul to dryer or storage		11	—	.9	0
Miscellaneous help [5]		11	—	.6	0
Sub-total				3.0	.6
Total				17.0	5.3

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[1] A few operators burned the stubble on fields previously in rice, and used land plane on some fields.

[2] About 40 percent of the farmers who dry seeded used endgate seeders and covered 75 to 100 acres per 10 hours. Water seeding was practiced exclusively by 12 farmers and partially by 9 farmers A crew of 4 to 6 men (excluding the pilot) is used and the time per acre averaged about 0.8 man hours.

[3] Includes cultipacker, roller, or harrow operations.

[4] Performance rate is for 10 hours of operating time, exclusive of the time required for servicing combines.

[5] Includes time for servicing combines, plus extra help in the field and at storage bins.

done with planes, at prevailing custom rates. The rates usually are on a per acre basis, varying, for fertilizer, with the amount of material applied. The cost usually ranges from $1 to $2 per acre for each application made.

Most farmers hire the services of commercial dryers for reducing the moisture content of rice to the level required for safe storage. Custom rates for drying are standard at about 15 cents per bushel. On an acre basis, the cost of drying usually is in the range of $10 to $12, depending on per acre yields.

Estimated Per Acre Costs and Returns

Based on the usual operations as previously described and on prices paid in 1958 for materials, services, and labor (appendix table 8), the estimated cost of producing rice is about $89.00 per acre (table 10.) This includes overhead costs for the farm equipment and power units, but does not include a charge for the land or farm service buildings, or for the management services of the operators.

Of the $89 total cost, $59 is for seed, fertilizer, herbicides, and services hired on a custom basis, $14 is for hired labor, and $16 is for overhead costs on the pumping plant and farm machinery. On the smaller farms a substantial share of the work is performed by the operator, and the cost of hired labor is consequently less than $14.

Gross income per acre varies with yield. It would average about $158 with an average yield per acre of 70 bushels, or 3,150 pounds. After the $89 total cost of materials, services, labor, and equipment use is deducted from the gross income, a total of about $69 per acre remains as return for land and management. This is return per acre in rice. The return per acre of cropland in the rotation is only about a third of this amount, as the rice allotment is usually about 30 percent of the cropland.

FARM ENTERPRISES RELATED TO RICE PRODUCTION

Typical rotation programs include periods of 2 to 4 years during which land is not used for rice. During these periods farmers attempt to reduce the infestation of noxious weeds and grasses that builds up during the seasons when rice is grown. This entails considerable costs, which farmers generally attempt to offset by growing other crops.

Soybeans are grown in rotation with rice more than any other crop. However, wheat is grown on an appreciable number of rice farms, and perhaps would be grown more extensively if wheat acreage allotments were not in effect. Oats are grown on some farms but poor surface drainage is a problem on many farms.

The production practices and requirements for these crops are somewhat different on rice farms than on cotton farms, because many of the operations are performed with equipment designed primarily for rice production, and because of the heavy clay soils of the farms specializing in rice production. In this section, the secondary enterprises are discussed briefly and the quantity and costs of materials, labor, and machinery time are summarized.

Soybeans

Soybeans were the most common secondary enterprise on the farms surveyed. Slightly more than 18,000 acres were planted on 65 of the 77 farms in 1958. Excessive rains after planting and also just before the harvesting season caused large acreages to be abandoned, and only about 13,000 acres were harvested, producing an average of 23 bushels per acre. The importance of soybeans varied between the farm groups. On the large rice-other crops farms slightly more than one-fifth of the cropland was used for soybeans, compared with about two-fifths of the cropland on small rice-cotton farms.

The land preparation for soybeans is done largely with rice production equipment such as offset disks, heavy tandem disks, and harrows. Slightly more than half of the farmers bedded the land with middle busters before planting, and the remainder planted "flat" after the last disking and harrowing. Land preparation is done mainly in the spring, but when weather is favorable during the late fall the initial one or two diskings may be done after crops are harvested.

On the farms in the survey, four-row equipment was used exclusively for planting and cultivating. Harvesting was done with the large self-propelled rice combines.

The total labor used for growing and harvesting row planted soybeans averaged about 5.5 man-hours per acre (table 11). Slightly over half the man hours were used in land preparation and planting, about 1.3 in cultivation, and 1.0 hour in harvesting. Tractor time averaged 4.1 hours per acre, all for land preparation and cultivation. The soybeans were harvested with rice combines, and operating time per acre was about 0.5 hour.

The only materials used in growing soybeans, other than fuel and oil for tractors, are the planting seed and the bacteria preparation for seed innoculation. Most farmers either purchased seed that had been cleaned and innoculated, or paid custom rates for having farm-grown seed cleaned and

Table 10. Estimated cost and returns per acre for rice, 1958 prices.

Item	Unit	Quantity	Price or rate	Value per acre
			Dollars	
Gross receipts:				
Grain	Cwt.	31.50	5.00	157.50
Cash expenses, except labor:				
Seed [1]	Bu.	3.6	3.75	13.50
Fertilizer [2] — nitrogen	Lbs.	54	.14	7.56
Herbicides	Acre	1.0	2.00	2.00
Insecticides	Acre	1.0	1.50	1.50
Applying fertilizer	Acre	1.0	1.00	1.00
Applying insecticides	Acre	1.0	1.75	1.75
Drying rice [3]	Cwt.	31.50	.33	10.40
Hauling rice [4]	Cwt.	31.50	.03	.94
Pump operation	Acre	1.0	10.72	10.72
Combine operation	Hour	.9	2.48	2.23
Tractor operation [5]	Hour	5.3	.93	4.93
Other equipment [6]	Hour	5.5	.40	2.20
Total				58.73
Labor:				
Pre-harvest, regular	Hour	5.2	.60	3.12
Pre-harvest, watering	Hour	8.2	1.00	8.20
Harvest	Hour	3.0	1.00	3.00
Total				14.32
Equipment overhead:				
Pumping plant [7]	Acre	1.0	4.15	4.15
Combine [8]	Hour	.9	6.45	5.80
Tractor	Hour	5.3	.63	3.34
Other	Hour	5.5	.50	2.75
Total				16.04
Total specified expenses				89.09
Returns to land, management, and general overhead				68.41

[1] Seeding rate is 3 bushels per acre and 1.25 times over.

[2] Price is based on ammonimum nitrate at 12.1 cents per pound and assumed use of some higher priced material.

[3] Based on custom rate at 15 cents per bushel.

[4] Estimated at 1.3 cents per bushel or equal to 6.5 cents per mile for round trip of 60 miles and hauling 300 bushels.

[5] Assumes work performed with 41 to 50 horsepower units—cost per 10 hours shown in Table 3 at $9.34.

[6] Allows .3 hour per acre for use of grain elevator

[7] Shown in Table 6.

[8] Based on 234 hours use per combine—harvesting 150 acres rice and 160 acres soybeans with annual overhead of $1,510 shown in Table 8.

treated. The cost of seed, including these treatments, averaged $3 per bushel.

The gross income from soybeans averaged $48 per acre (table 12). The total cash and noncash costs (including labor) averaged about $22 per acre, leaving $26 per acre as returns to land, management, and general overhead.

Small Grains

Where there is good surface drainage, wheat and oats are well adapted to the heavy clay soils of the rice farms in the Delta, and fit reasonably well into rice rotation programs. They usually are seeded on land that was idle and fallowed during the previous summer, or on land from which early-maturing varieties of soybeans have been harvested. The risk of failing to get small grains seeded in good condition and at the optimum seeding dates is greater when they follow soybeans, since the problem of survival through winter freezes is enhanced.

Small grains mature in June, and if harvesting is not delayed unduly by rain, the land can be double cropped with late planted soybeans. However, because of the risks involved in double cropping, some farmers prefer to summer plow the land, preparatory to seeding rice or soybeans the following spring.

Land preparation for small grains is performed with the same equipment as for rice, with slightly fewer times over. Planting is done with grain drills usually, but endgate seeders are also used extensively. After seeding, a harrow or cultipacker is used to cover the seed and firm the surface of the fields. Drain furrows are plowed at intervals to improve surface drainage. Fertilizer is applied in the spring with either planes or ground equipment.

Total preharvest labor for small grains averages about 2.9 man hours and 2.4 tractor hours per acre (appendix table 9). An additional 1.6 man hours are used in combining and hauling to storage.

The yields of wheat and oats are quite variable, depending largely on weather at harvest time. Excessive

Table 11. Usual operations performed and labor and power used per acre for soybean production.

Operations	Date performed	Rate per day	Times over	Hours per acre	
				Man	Tractor
		Acres	No.	Hours	Hours
Land preparation:					
Offset disk	3/1 to 6/1	20	2	1.0	1.0
Tandem disk	3/1 to 6/1	30	1	.3	.3
Harrow	3/1 to 6/1	40	2	.5	.5
Row (middle-buster)	4/1 to 6/1	20	1	.5	.5
Miscellaneous [1]	3/1 to 6/1	—	—	.3	.2
Sub-total				2.6	2.5
Planting:					
4-row planter	5/1 to 6/20	38	1.3	.6	.3
Cultivation: [2]					
Rotary hoe	5/20 to 7/10	70	2	.3	.3
Other	6/10 to 8/1	30	3	1.0	1.0
Sub-total				1.9	1.6
Combine [3]	10/15 to 11/20	18	1	.5	0
Haul to storage		18	—	.3	0
Miscellaneous help [4]		—	—	.2	0
Sub-total				1.0	0
Total for row planted soybeans [5]				5.5	4.1
Total for flat planted soybeans				(5.0	3.6)

[1] Includes removal of previous crop aftermath, and other miscellaneous operations.

[2] Seven of the forty-five farmers sprayed in spots and/or around edges of fields with toxaphene for grasshoppers. One farmer sprayed for weed control with 2-4D.

[3] Performance rate is for 10 hours of operating time, exclusive of the time required for servicing combines.

[4] Includes time for servicing combines, plus extra help in the field and at storage and selling facilities.

[5] Slightly over half of the soybeans were rowed, the remainder were planted flat.

lodging is a problem, particularly with oats, when heavy rains and winds occur during the ripening period.

Based on an estimated yield of wheat of 28 bushels per acre, the gross receipts per acre at 1958 prices would average $53 per acre (table 13). Direct expenses for materials, seed, and machinery are estimated to average $16 per acre, and for labor slightly over $3. Total expenses including overhead costs on equipment are estimated at $26 per acre, leaving about $27 per acre as returns to land, management, and general overhead.

Estimated returns for oats are considerably less than for wheat, except in years when yields are unusually favorable. Gross returns were estimated to have averaged about $38 per acre in 1958, based on yields of 55 bushels per acre and a price of 70 cents per bushel (table 14). Except for slightly lower costs for seed, per acre production costs are about the same as for wheat. Total cash and non-cash expenses are estimated at $24 per acre, leaving a return of $14 per acre to land, management, and general overhead.

Summer Fallow

About two-thirds of the farmers included in the survey summer fallowed some of their cropland during 1958. For all survey farms, summer fallow ranked third in amount of land involved, being exceeded only by rice and soybeans.

In the rotation cycle, land is usually summer fallowed during the season before it is returned to rice production. On individual farms the amount of land that is fallowed is related to the acres of rice grown and to the acres of other crops. Farmers who do not grow other crops in rotation with rice often fallow about the same acreage each year as they plant to rice. In this way the land is in good condition for seeding to rice the following spring, and the risks of not being able to seed at the optimum time are reduced. Other farmers fallow only about half as many acres each year as they seed to rice, and make complete land preparation on the remaining acreage immediately before seeding. This allows more land to be used for soybeans or other summer-growing crops in rotation with rice. Of the 56 farmers in the survey who reported some land fallowed, 22 fallowed as much or more land as they had in rice, and 15 fallowed 50 to 99 percent as much as they planted to rice.

Summer fallowing usually involves

Table 12. Soybeans: Estimated cost and returns per acre, 1958 prices.

Item	Unit	Quantity	Price or rate	Value per acre
			Dollars	
Gross receipts:				
Grain[1]	Bu.	23	2.10	48.30
Cash expenses, except labor:				
Seed	Bu.	1.2	3.00	3.60
Hauling	Bu.	23	.02	.46
Tractor operation	Hour	4.1	.93	3.81
Combine operation	Hour	.5	2.48	1.24
Other equipment operation	Hour	4.1	.40	1.64
Total				10.75
Labor:				
Pre-harvest	Hour	4.5	.60	2.70
Harvest	Hour	1.0	1.00	1.00
Total				3.70
Equipment overhead:				
Tractor	Hour	4.1	.63	2.58
Combine	Hour	.5	6.45	3.22
Other	Hour	4.1	.50	2.05
Total				7.85
Total specified expenses				22.30
Returns to land, management, and general overhead				26.00

[1] On land with good surface drainage a yield of 30 bushels per acre is about average and for land with inadequate surface drainage a yield of 18 bushels is about average.

disking the land from 3 to 5 times, plus the basic levee building operations (appendix table 10). The first disking is usually done in late June or early July. If the previous crop was rice, the old levees are "pulled down" first, and if necessary the old stubble is burned to allow for effective land tillage. The first one or two diskings are done with heavy offset disks, at 2 to 4 weeks intervals, followed in late August or September by disking from 1 to 3 times over with cutting disks. These operations are followed, relatively soon, with levee marking and building operations. If the operator prefers not to have water standing on the fields during the winter, the levees are cut at intervals to permit drainage of surface water. However, the practice of closing the levees and maintaining water on the land until near seeding time has increased in recent years.

The total fallowing operations usually require about 3.5 hours of man labor, and 3.0 hours of tractor and machinery time. At the usual rates, fuel and labor costs average about $6 per acre, and total expenses, including overhead cost for the tractor and equipment, average about $9 per acre.

Land that has been fallowed the previous season requires some preparation before seeding in the spring. Usually it is disked a couple of times, and harrowed once or twice. After seeding, the levees are completed in the usual manner. Total labor for summer fallowing, spring preparation, and all levee building operations (excluding seeding) averages about 6 man hours per acre. This compares with slightly over 4 man hours per acre for nonfallowed land on which complete land operations are performed in a relatively short period just before seeding.

Table 13. Wheat: Estimated cost and returns per acre, 1958 prices.

Item	Unit	Quantity	Price or rate	Value per acre
			Dollars	
Gross receipts:				
Grain	Bu.	28	1.90	53.20
Cash expenses, except labor:				
Seed, cleaned and treated[1]	Bu.	2.6	2.25	5.85
Fertilizer	Cwt.	1.5	3.65	5.47
Hauling	Bu.	28	.02	.56
Tractor operation	Hours	2.1	.93	1.95
Combine operation	Hours	.6	2.48	1.49
Other equipment	Hours	2.1	.40	.84
Total				16.16
Labor:				
Pre-harvest	Hours	2.6	.60	1.56
Harvest	Hours	1.6	1.00	1.60
Total				3.16
Equipment overhead:				
Tractor	Hours	2.1	.63	1.32
Combine	Hours	.6	6.45	3.87
Other	Hours	2.1	.50	1.05
Total				6.24
Total specified expenses				25.56
Returns to land, management, and general overhead				27.64

[1] Price allows for cleaning if produced on farm.

Table 14. Oats: Estimated costs and returns per acre, 1958 prices.

Item	Unit	Quantity	Price or rate	Value per acre
			Dollars	
Gross receipts:				
Grain	Bu.	55	.70	38.50
Cash expenses, except labor:				
Seed	Bu.	3.2	1.25	4.00
Fertilizer	Cwt.	1.5	3.65	5.47
Hauling	Bu.	55	.02	1.10
Tractor operation	Hours	2.1	.93	1.95
Combine operation	Hours	.6	2.48	1.49
Other equipment	Hours	2.1	.40	.84
Total				14.85
Labor:				
Pre-harvest	Hours	2.6	.60	1.56
Harvest	Hours	1.6	1.00	1.60
Total				3.16
Equipment overhead:				
Tractor	Hours	2.1	.63	1.32
Combine	Hours	.6	6.45	3.87
Other	Hours	2.1	.50	1.05
Total				6.24
Total specified expenses				24.25
Returns to land, management, and general overhead				14.25

APPENDIX

Appendix Table 1. Summary of investment in, and annual overhead costs for, typical inventories of equipment for small and large rice farms, Delta Area of Mississippi.

Farm size	Investment 1958 new value	Annual repairs	Annual depreciation	Interest charge[1]
		Dollars		
Small farms:				
Trucks	3,250	150	217	97.50
Tractors	15,900	1,031	1,326	477.00
Land tillage and farming equipment	6,050	270	553	181.50
Seeding and distributing equipment	1,120	66	79	33.60
Harvesting equipment	9,535	375	986	286.05
Miscellaneous[2]	2,000	200	250	60.00
Sub-total	37,855	2,092	3,411	1,135.65
Equipment for row crop and pasture	1,975	125	198	59.25
Total	39,830	2,217	3,609	1,194.90
Large farms:				
Trucks	8,200	400	647	246.00
Tractors	26,400	1,784	2,201	792.00
Land tillage and farming equipment	11,125	520	1,031	333.75
Seeding and distributing equipment	1,220	76	86	36.60
Harvesting equipment (carts and elevators)	19,720	800	2,641	591.60
Miscellaneous	6,000	800	800	180.00
Sub-total	72,665	4,380	7,406	2,179.95
Equipment for row crops and pasture	2,780	185	261	83.40
Total	75,445	4,565	7,667	2,263.35

[1] 6 percent on ½ of 1958 new value.

[2] Includes portable motors, fuel tanks, trailers, welders, and other shop equipment, and miscellaneous hand tools.

Appendix Table 2. Estimated 1958 cost, annual use, repairs and depreciation for principal equipment items used on rice farms, Mississippi Delta.

Items	New cost 1958	Estimated annual use	Annual repair costs	Annual depreciation	Usual number per farm	
					Small	Large
	Dollars		Dollars		Number	
Trucks—						
1½ ton and larger	3,250	4,000 mi.	150	325	1	2
Pickups	1,700	10,000 mi.	100	313	—	1
Tractors—						
Under 30 hp.	3,000	85 days	200	250	1	1
31 to 40 hp.	4,100	85 days	233	342	2	2
41 to 50 hp.	4,700	85 days	365	392	1	2
51 to 60 hp.	5,800	85 days	388	483	—	1
Disks—						
Offset	950	26 days	50	95	1	3
Tandem	1,000	26 days	50	100	2	3
Levee	525	6 days	25	53	1	2
Harrows—All types	250	10 days	25	25	2	5
Cultipacker	475	13 days	20	48	1	1
Land leveler	700	20 days	15	47	1	—
Land plane	1,600	20 days	15	107	—	1
Grader	900	12 days	10	60	1	1
Grain drill	600	6 days	23	40	1	1
Fertilizer distributor	400	3 days	10	27	1	1
Endgate seeder	100	6 days	10	7	—	1
Spray boom	120	7 days	33	12	1	1
Grain cart	800	16 days	12	40	1	2
Grain elevator	650	20 days	50	65	—	1
Combines	8,735	26 days	375	1246*	1	2
Row crop equipment:						
Middle buster	530	NA	40	35	—	1
Planter	650	NA	40	65	1	1
Cultivator—2 row	300	NA	20	30	1	—
4 row	575		40	58	1	2
Mower	450		25	45	1	1

*Based on average life of 7 years and applicable to large farms. Operators of small farms estimated life of combines at 9.2 years, which reduced the annual depreciation to $946.

Appendix Table 3. Representative investments in farm buildings and wells and annual overhead costs for small and large rice farms, Delta Area of Mississippi.

Item	Original investment	
	Small farms	Large farms
	Dollars	
Farm shop	500	750
Machinery shed	840	1,925
Grain storage*	4,200	8,000
Total	5,540	10,675
Irrigation wells**	5,500	16,500
Annual overhead costs:		
Buildings:		
Repairs	178	400
Insurance	141	678
Depreciation***	277	534
Irrigation wells:		
Interest	165	495
Depreciation***	433	1,299

*On farms reporting grain storage the capacity of bins installed averaged 12,000 bushels on small farms and 20,000 bushels on large farms.

**Includes 1 well on small farms and 3 wells on large farms.

***Depreciation on buildings based on average life of 20 years, and on wells (including pump and motor) based on average life of 15 years.

Appendix Table 4. Number, days of use, and average repair costs, for tractors of varying sizes.

Size of tractors	Small farms			Large farms		
	Tractors	Average per tractor		Tractors	Average per tractor	
		Use	Repairs		Use	Repairs
Horsepower	**Number**	**Days**	**Dollars**	**Number**	**Days**	**Dollars**
21 to 30	17	55	90	44	78	60
31 to 40	25	67	118	48	76	101
41 to 50	13	60	168	32	106	190
51 to 60	1	*	*	27	98	210
61 and over	4	*	*	12	90	138
Total or average	60	61	129	163	85	126

*Averages omitted because of small number in group.

Appendix Table 5. Estimated fuel consumption for tractors of varying horsepower ratings when performing medium and heavy load jobs.

Size of tractor	Estimated fuel used per 10 hours*			
	Butane		Diesel	
	Medium load	Heavy load	Medium load	Heavy load
Horsepower	**Gallons**		**Gallons**	
21 to 30	20	30	—	—
31 to 40	43	48	17	25
41 to 50	58	62	22	29
51 to 60	—	—	27	34
61 and over	73	78	31	36

*Most tractors used in rice field operations were diesel burning tractors, with butane being the second most common fuel used. A number of gasoline burning tractors were reported. They were mostly of the smaller horsepower units, and probably were used largely for miscellaneous farm service jobs.

Appendix Table 6. Size and usual composition of harvesting crews used for harvesting rice.

Combines	Harvesting crews		
	Small farms	Large farms	All farms
Number	**Number**	**Number**	**Number**
1	8	3	11
2	12	24	36
3	2	7	9
4	2	5	7
5 or more	0	4	4
Usual machines and men per crew:			
Combines			2
Grain carts (Incl. tractor)			1
Trucks			2
Men			5
Acres harvested per day*			16.6

*Two combines operated 7.5 hours.

Appendix Table 7. Average price of combines by year of purchase.*

Year bought	Number of combines	Average price
	Number	Dollars
1958	13	8,735
1957	10	7,690
1956	10	7,077
1955	10	7,153
1954	9	6,222
1953	6	6,967
1952 and earlier	9	5,946
Total or average	67	7,225

*Only includes combines purchased new.

Appendix Table 8. Prices paid for items purchased and received for products sold, 1958.

Item	Unit	Cost
Prices paid:		Dollars
Hired labor:		
Pre-harvest (except watering)	Hour	.60
Irrigation labor	Hour	1.00
Harvest labor	Hour	1.00
Custom services:		
Drying rice	Bushel	.15
Plane application:		
Fertilizer	Acre	1.00
Insecticide	Acre	1.75
Fertilizer:		
Nitrogen	Pound	.14
Am. Nitrate	Ton	73.00
Fuel and lubricants:		
Gasoline (combine)	Gallon	.22
Diesel fuel (tractor)	Gallon	.16
Oil	Gallon	.85
Grease	Pound	.20
Planting seed:		
Rice	Bushel	3.75
Soybeans	Bushel	3.00
Oats	Bushel	1.25
Wheat	Bushel	2.25
Prices received:		
Rice	Cwt.	5.00
Soybeans	Bushel	2.10
Oats	Bushel	.70
Wheat	Bushel	1.90

Appendix Table 9. Usual operations performed and labor and power used per acre for small grain production.

Operations	Dates performed	Rate per day	Times over	Hours per acre	
				Man	Tractor
Offset disk*	9/20 to 11/1	25	1	.40	.40
Tandem disk	9/20 to 11/1	30	2	.66	.66
Harrow	9/20 to 11/1	40	2	.50	.50
Plant	9/20 to 11/1	30	1.3	.86	.43
Cultipack	9/20 to 11/1	50	1.3	.26	.26
Plow drain furrows	9/20 to 11/1	200	1.3	.07	.07
Fertilizer	3/15 to 4/1	160	1.0	.12	.06
Sub-total				2.87	2.38
Combine	6/20 to 7/20	18	1.0	.55	—
Haul		—	—	.55	*
Miscellaneous		—	—	.55	—
Sub-total				1.65	
Total				4.52	2.38

*Assumes that small grain follows other summer or fall harvested crops. If small grain is seeded after summer fallowing this operation and possibly one other disking would not be needed.

Appendix Table 10. Usual operations performed and labor and power used per acre for land in summer fallow.

Operations	Dates performed	Rate per day	Times over	Hours per acre		
				Man	Tractor	Machine
		Acres	No.		Hours	
Offset disk	6/15 to 9/1	17	2	1.2	1.2	1.2
Tandem disk	10/1 to 12/1	30	2	.7	.7	.7
Miscellaneous*	10/1 to 12/1	—	—	.3	.2	.2
Total				2.2	2.1	2.1
Survey and mark levees	10/1 to 12/1	60	1	.5	.2	.2
Pull levees	10/1 to 12/1	50	2	.4	.4	.4
Cut levee	10/1 to 12/1	—	1	.3	.2	.2
Total				1.2	.8	.8
All operations				3.4	2.9	2.9

*Allowance for removal of crop aftermath, removal of old levees and some land forming operations.

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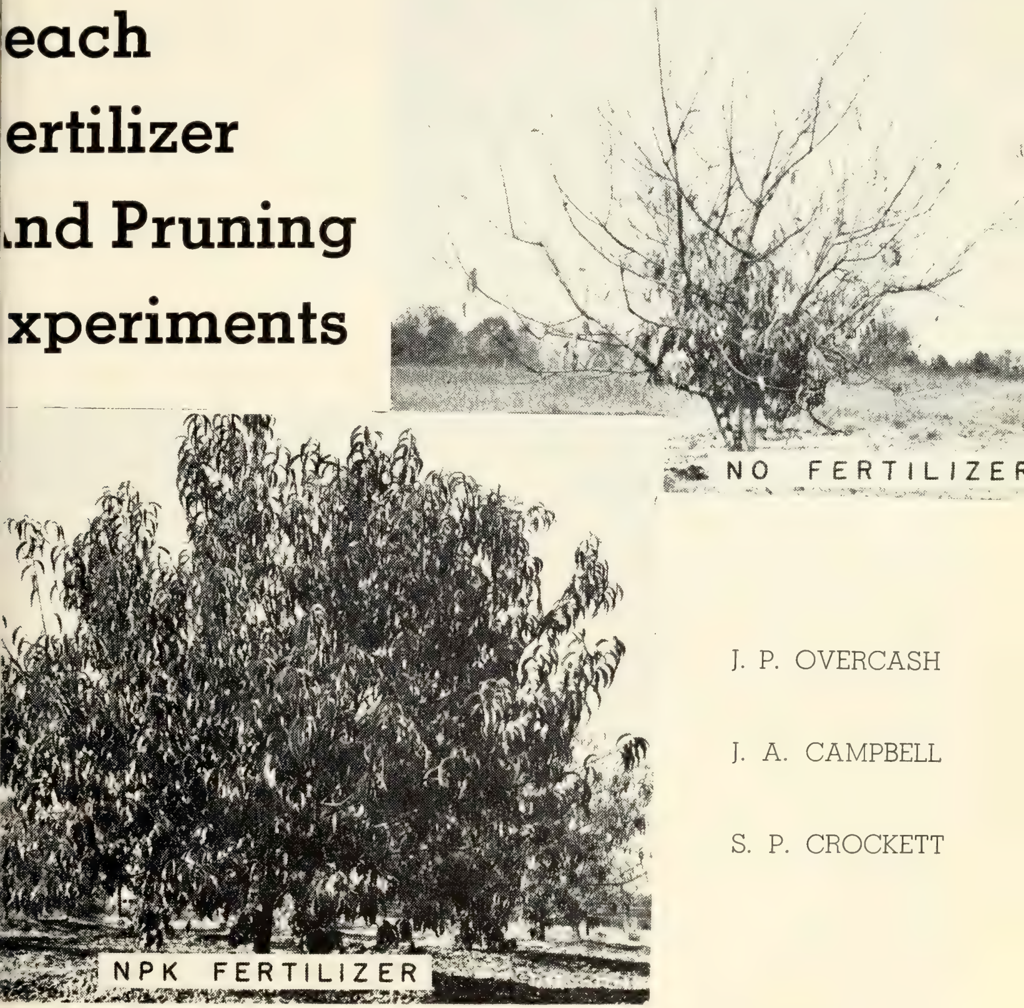

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Figure 1. Five-year-old Sullivans Early Elberta peach trees on October 24, 1950 at Crystal Springs, Mississippi. Tree on left received annual applications of nitrogen plus phosphorus plus potassium fertilizers and the tree on the right received no fertilizer.

PEACH FERTILIZER AND PRUNING EXPERIMENTS

By J. P. OVERCASH,[1] J. A. CAMPBELL[2]
and S. P. CROCKETT[3]

Introduction

Nutrition

Prior to the experiments reported herein, no adequate experiments had been conducted to determine the response of peach trees to phosphorus and potassium fertilizers in Mississippi. Experiments reported from other peach growing areas have indicated that the phosphorus and potassium supplying capacity of many soils is inadequate for optimum tree growth, when nitrogen is maintained in the soil at a fairly high level.

Nitrogen is one of the major fertilizer elements most likely to be deficient in soils in Mississippi. Heavy annual rainfall in this state, particularly during the winter months, makes leaching of readily available nitrogen from the soil a major problem. This is why a split application (one in early spring before growth begins and another in late June or early July) has commonly been recommended.

Nitrogen in the peach tree is necessary to aid shoot and leaf growth. It also helps to keep dark green, functional leaves on the trees and maintain them until late fall. These leaves continue to produce organic food materials after external growth extension has stopped. The food manufactured in excess of that which is used in the formation of new tissues or in respiration, is stored to be used later in the life of the tree. It is used during the early spring growth period until new leaves have been formed and begin to manufacture food materials for use throughout the rest of the tree during late spring, summer and fall.

Nitrogen in the tree is also essential for the initiation and development of fruit buds in mid-summer and for fruit-set the next spring. This is why it is highly desirable that early spring fertilizers be applied so that part of the nitrogen will be absorbed by the roots before visible top growth begins. Ample supplies of nitrogen in the tree also insure good fruit size and quality, if thinning is properly done.

Experiments in other states have shown that trees receiving nitrogen fertilizers during the summer were much less subject to winter injury than those receiving none. There was a marked decrease in winter injury with an increased rate of application of nitrogen, within certain limits, in areas subject to winter injury.

In areas where earliness of fruit harvest is extremely important, the spring nitrogen application is kept to a minimum. Peach fruit maturity is known to be delayed with increased rates of application of nitrogen. This is not a major problem in Mississippi peach production at present. This effect is less pronounced on sandy soils due to the fact that they have a more rapid nitrogen cycle resulting from a low organic matter content. Large crops delay maturity because of the greater drain on the carbohydrate supply of the peach tree. Suitable thinning helps to relieve this delay in maturity somewhat, because it makes a larger amount of carbohydrates available per fruit.

Chemical analyses of peach trees and fruits have shown that they have a relatively low phosphorus requirement for normal tree and fruit growth. A 600-bushel crop uses approximately 95 pounds of nitrogen, 30 pounds of P_2O_5, and 120 pounds of K_2O for leaf, wood and fruit growth for one year. Phosphorus deficient trees are seldom seen in Mississippi except on very sandy soils. Many peach orchards are grown on soils formerly used for cotton or other row crops which were fertilized with NPK mixtures. Many soils are retentive of phosphorus and this reserve may be available for subsequent crops. Phosphorus is necessary to aid in cell division in peach trees.

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The potassium needs of a peach tree are much larger than the phosphorus requirements. Most mineral soils, except those of a sandy nature, are high in total potassium content. This does not mean that it is all readily available for absorption by plant roots. In fact, the amount of potassium held in an easily exchangeable condition in many soils is usually small. Potassium is necessary for carbohydrates formation and plays an important role in regulating the nitrate reserves in many plants. It is also necessary for protein formation.

Potassium is freely translocated throughout the plants. Trees with a heavy fruit crop, and a deficient supply of potassium will transfer this element to the developing fruits and the vegetative growth will then be limited.

In peaches, as well as in other crops, the nitrogen, phosphorus, and potassium requirements are inter-related. It is well to remember that a plant can grow only to the extent that some nutrient element or environmental factor becomes limiting. In many orchards the phosphorus and potassium supplying power of a particular soil may be sufficient for a peach tree which receives no nitrogen fertilizer. These same amounts of available phosphorus and potassium may be totally inadequate to support optimum growth where heavy rates of nitrogen fertilizer are used.

Plants must compete with the soil microorganisms for the available nutrients. If there is a deficit of any element, the needs of the soil flora and fauna are satisfied first. Thus, fertilizer applications should be large enough to adequately supply the needs of trees and soil organisms and for the chemical fixation as well as losses due to leaching.

Within the past fifteen years, the United States Census reports have shown varying numbers of peach trees in Mississippi. The numbers have been as high as 1,250,000 and as low as 376,000. Any fertilizer practice which would improve yields from these trees by half bushel or more per tree would be of special importance to peach growers and of considerable economic value.

Pruning

The purpose of pruning a peach tree is to improve its shape, influence its vegetative growth, flowering and fruitfulness, improve the fruit quality. remove dead wood and to repair an injury to the tree.

Experiments have invariably shown that pruning is a dwarfing process. The total growth attained by an unpruned tree is always greater than that of a pruned tree, regardless of the amount or type of pruning. Pruning not only reduces the top growth of a tree but also reduces the amount and length of root growth because of reduced food production.

Pruning tends to increase the percentage of the flowers on a tree which develop into fruits. Peach trees produce fruits from lateral flower buds on twigs which grew the previous season. It is therefore important to practice a type of culture and pruning which encourages new growth each year at locations on the tree which result in good fruit distribution. Since flower buds are formed in mid-summer, it is especially important to consider practices which influence the amount and kind of vegetative growth prior to this time.

The primary purpose of training a young tree is to develop a tree that will support a large amount of high quality fruit. This objective is achieved by developing a strong well balanced framework, which is capable of supporting heavy crops without extensive limb damage. The training of peach trees is a very important phase of fruit production.

In general, peaches are trained to an open center or modified leader system. The open center system is more popular because it aids the penetration of sunlight into the tree to help with maturation and coloration of the fruit. This system of training also makes easier the fruit harvest from the center of the tree.

The experiments conducted on pruning severity, and reported here, deal primarily with pruning mature trees. They were started after the initial period of tree training was over. These studies were made to determine how very light pruning contrasted to very severe pruning would influence fruit production. In many southern commercial peach areas very severe pruning is practiced.

Materials and Methods

Establishing the Orchards

Two orchards were established in March of 1946 to study the influence of nitrogen, phosphorus and potassium fertilizers on the growth and fruit production of the trees. One orchard was planted at the North Mississippi Branch Experiment Station at Holly Springs, in the extreme northern part of the state. The other orchard was set at the Truck Crops Branch Experiment Station at Crystal Springs, in the south central part of the state, 30 miles south of Jackson.

The orchard site selected at Holly Springs was a Grenada silt loam soil, adjacent to an old peach orchard. This soil type is widespread in North Mississippi, of large total acreage, and agriculturally important. It is moderately well drained. The site chosen at Crystal Springs was a Providence soil classified as a moderately deep, permeable, sandy loam with fairly good internal drainage. Both of these soils are of loess origin.

Each orchard was about two and one-half acres in size and contained about 275 trees. The trees were spaced 20 x 20 feet in each orchard. The sloping nature of the sites made contour planting designs desirable at each location.

Sullivans Early Elberta was chosen as the variety to be used because of its mid-season ripening. "June-bud" type of trees in the 2 to 3 foot size range were obtained from a commercial nursery, planted and trained according to recommended procedures.

Cultural Practices

The clean cultivation-winter cover crop system of soil management was practiced. The orchards were uniformly clean cultivated every summer throughout the experiments. In the fall of each year a cover crop of oats was drilled in the middles, between the tree rows, to reduce soil erosion resulting from heavy winter rains. These oats were disked into the soil as early as possible in the spring. Clean culture was maintained by disking between the rows and hoeing under the trees.

During the first two summers the trees were given light applications of nitrate of soda. This was applied by hand, uniformly to all trees, and evenly distributed in a circular soil area about the size of the tree top.

The trees were summer pruned and trained the first year to develop the framework properly, and were subsequently trained to a moderately open center system. At the beginning of the differential fertilizer applications, and thereafter throughout the life of the orchard, the trees were pruned annually in the winter at a level of severity hereafter termed "medium". Subsequently, in 1950, the whole-row borders were used for a pruning severity test.

For medium pruning about one-third of the previous season's growth was removed each winter. This was accomplished by visual estimates and the weight in pounds of prunings was annually recorded for each tree throughout the experiment. Both "heading back" (removing portions of long shoots) and "thinning out" (removing whole shoots) were practiced in order to maintain new shoots throughout the entire tree for the next year's crop. Corrective pruning such as removal of dead, injured and diseased or interfering limbs was practiced along with the heading back and thinning out work. Continued estimates were made to remove only about one-third of the previous season's growth.

Insect and disease control was obtained by following the recommendations in the Mississippi Spray Calendar. Annual dormant sprays were applied to control scale insects and ethylene dichloride emulsion was applied for peach tree borer control. Summer insects and diseases of the trees and fruit were controlled by regular sprays of insecticides and fungicides.

Tree measurements were made each winter before pruning to determine the tree sizes attained to that date. The tree height and width were recorded in feet. Tree width was recorded in the same direction as the tree rows, thus permitting constant checks on changes from the previous year. The trunk circumference was measured to the closest half-inch each year at a fixed point on the tree marked by a nail and about halfway between the soil and the tree crotch.

Each year that a crop was produced the fruits were hand thinned in order to prevent an over-load and limb breakage. One field crew did all of the thinning each year, without interruption, and went through the orchard from one side to the other without regard to treated or untreated trees. An attempt was made to thin the fruits so they would not touch at maturity.

The fruits were harvested at intervals of two to four days during the ripening season. They were handpicked at the tree ripe (but firm) stage into bushel baskets and the weights recorded. Individual trees were picked from two to six times each season depending on the evenness of ripening of fruit.

Earliness of ripening was determined by using the total weight of fruit picked on the first two harvest dates as early yield each year. This was calculated as percent of the total yield. The percent figures were transposed to angles for statistical analyses and significant differences shown in the tables of the original percentage data are shown with asterisks.

NPK Fertilizer Experiments

In March of 1948, the NPK factorial experiment was begun at Crystal Springs by applications of differential fertilizers. The beginning of an identical experiment in the Holly Springs orchard was delayed until May of 1948. This delay at Holly Springs was due to winter injury resulting from a temperature of —5° F during the previous winter. It was desirable to determine the extent of this tree injury before making the applications of fertilizers.

The plot layout was arranged so that each two-tree plot was entirely surrounded by border (no fertilizer) trees. This result was obtained by using one border tree between plots within a row and an entire border row between the rows on which the plots were located. These whole-row borders were maintained until 1950 when they were used for a pruning severity and fertilizer rates experiment. Eight fertilizer treatments were included: 1. nitrogen (N) only; 2. phosphorus (P) only; 3. potassium (K) only; 4. nitrogen and phosphorus (NP); 5. nitrogen and potassium (NK); 6. phosphorus and potassium (PK); 7. nitrogen and phosphorus and potassium (NPK); and 8. check (no fertilizer). These treatments were located at random in each of four blocks of the orchard.

The nitrogen fertilizer chosen for this experiment was nitrate of soda containing 16 percent nitrogen. The rate of application was one pound per tree per year of age until the sixth year. Thereafter, the maximum rate was six pounds per tree per year. Soil analyses for pH were made annually and these rates of application resulted in raising the pH to near the neutral point. Thereafter, the nitrogen source was changed to ammonium nitrate containing 33 percent nitrogen in alternate years to reduce this unfavorable pH. The ammonium nitrate was applied at the rate of one-half pound per tree per year of age. The maximum rate of ammonium nitrate was three pounds for six-year-old trees and older.

The nitrogen fertilizers were applied in split applications. Two-thirds was applied about two weeks before blossom time to aid fruit-set. The remainder was applied in late June or early July to maintain the high chlorophyll content of the leaves and to hold them on the trees until the end of the growing season. In this way, maximum quantities of carbohydrates were available for growth processes the following spring.

All of the phosphorus and potassium fertilizers were applied in early spring. Phosphorus was applied at the rate of one pound of 20 percent superphosphate per tree per year of age to six years and thereafter at the six-year-rate of six pounds per tree. The potassium was applied at the rate of ¼ pound of 50 percent muriate of potash per tree per year of age to six years. Thereafter, it was applied at the maximum rate of 1½ pounds per tree each year.

Pruning and NPK Rates Experiment

The decision to establish a test on the border rows was reached after the report of Lott, Satchell and Hall, which stated that mature muscadine grape vines had shown very little "cross-feeding" between rows which had been cultivated regularly. They used radio-active phosphorus as a tracer technique to detect root extension. An experiment dealing with pruning severity and NPK rates was started on the whole-row borders separating the NPK experiment. This experiment was begun in the spring of 1950 after the trees had been in the orchards for four years. The training phase of the trees was completed and the trees were in a mature bearing state with their framework well developed.

In order to eliminate the possible crossing over of tree roots, a narrow plow was tractor drawn in the middles between each row to a depth of about 12 inches at the beginning of these experiments and in early spring of each year thereafter. This removed or severed to a depth of 12 inches any roots that may have crossed between rows, and subsequently no visual signs of cross-feeding resulted.

The pruning severity and NPK rates experiment was arranged on the border rows and single border trees separated the two-tree plots within each row. When border trees occurred in the next row, but adjacent to plots receiving 2(NPK) rates, there were no visible symptoms of any cross feeding. In years when premature defoliation of low nitrogen fertilized trees occurred in the fall, these adjacent border trees closely resembled the check plots and were also prematurely defoliated in a manner similar to the check (no fertilizer tree) and is well illustrated in figure 1.

Three levels of pruning severity (light, medium and heavy) and two rates of NPK fertilizer application were included. The pruning severity standards at the beginning of the experiment may be seen in figure 2, and are described below.

Light pruning consisted of the corrective type. Only broken, seriously interfering, or crossed limbs were removed.

Medium pruning had a range of 25 to 50 percent of the previous season's growth removed. This was accomplished by thinning out twigs and heading back long vigorous twigs. Visual estimates were made of the prunings removed and about one-third of the new wood was removed. These prunings were weighed annually for each tree.

Heavy pruning was similar to the

pruning observed in the southernmost commercial peach growing areas of the southeastern United States. About two-thirds of the growth made the previous growing season was removed. The range of twig removal was 50 to 75 percent.

Because of the possibility that the fertilizer requirements might vary for trees pruned to different levels of severity, a NPK rate test was planned at the same time as the pruning test. Two rates of NPK application were combined with each pruning level. Two-tree plots were used with a single border tree between plots on each row. These treatments were located at random in each of four blocks of the orchard.

The NPK rate used in the fertilizer element experiment was employed as the low rate in this experiment. These rates per tree per year of age, to six years and each year thereafter at the six-year-rate were: nitrogen, one pound of 16 percent or one-half pound of 33 percent nitrogen fertilizer; phosphorus, one pound of 20 percent superphosphate; and potassium, one-fourth pound of 50 percent muriate of potash. The high rate used has been designated as 2(NPK) and involved exactly twice the amounts of each element used in the low rate of NPK. A three-year-old tree received NPK at the rate of three pounds of 16 percent nitrogen, 3 pounds of 20 percent superphosphate, and 3/4 pound of 50 percent muriate of potash. A three-year-old tree received 2(NPK) at the rate of 6 pounds of 16 percent nitrogen, 6 pounds of 20 percent superphosphate, and one and one-half pounds of 50 percent muriate of potash.

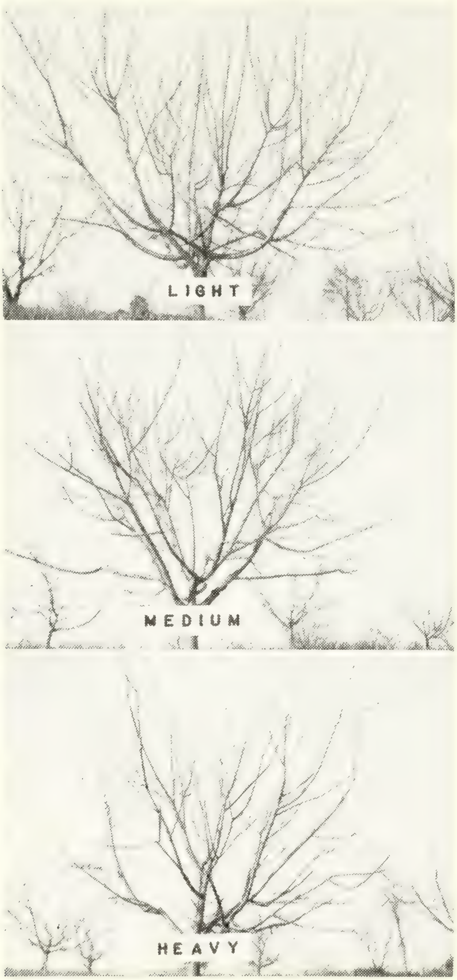

Figure 2. Four-year-old peach trees pruned to three levels of severity. Light, only broken, crossed or interfering limbs removed. Medium, removed about one-third of previous season's growth. Heavy, removed about two-thirds of previous season's growth.

Results of NPK Fertilizer Experiments

Tree Measurements

The first obvious differences observed were in tree growth. Data for selected years which indicate the general trends are shown in tables 1 to 4. The annual prunings removed a portion of the height and width of the trees, but as a percentage of previous season's growth, the amount was a relative constant for all trees.

Tree height was undoubtedly restricted more than width by annual pruning because of the necessity of keeping the trees from becoming too high. Both at Crystal Springs and at Holly Springs, the trees fertilized with NPK were always significantly higher than the check trees.

In general, all trees receiving nitrogen fertilizer (alone or in combination with phosphorus or potassium) were taller than the check trees. The means for all trees receiving nitrogen fertilizer (N, NP, NK, NPK) were significantly higher than the means for all trees receiving no nitrogen, (P, K, PK, check). The summary of means for height of all trees receiving either phosphorus (P, PK, NP, NPK) or potassium (K, NK, PK, NPK) were no larger than the summary of means of trees which did not receive these elements.

The width of the trees was influenced by the fertilizer elements in the same direction as the height but was slightly more pronounced as shown by a greater frequency of highly significant differences between the check trees and the trees receiving NPK fertilizer in both orchards. The width of all trees receiving nitrogen fertilizer in the Holly Springs orchard was 50 percent larger than for all trees receiving no nitrogen as shown by their means in table 2.

These data indicate that it is necessary to make annual applications of nitrogen fertilizer in order to obtain sufficient tree size, as indicated by tree width, for the production of large crops of fruit.

Trunk size, whether measured by diameter, circumference or cross-sectional area, is generally a reliable measure of over-all tree growth. In these experiments this relationship generally held true. The average trunk circumference for plots receiving nitrogen fertilizer was larger than the average for plots which did not receive nitrogen fertilizer (tables 3 and 4). In the Holly Springs orchard the trees receiving NPK fertilizers annually had significantly larger trunk circumferences than the trees receiving no fertilizer. Furthermore, when the means for trunk circumferences of all trees receiving nitrogen fertilizer in this orchard were compared with the means for all trees which did not receive nitrogen fertilizer they were significantly larger.

Neither phosphorus nor potassium when applied alone resulted in increases in trunk circumferences at either location. Furthermore, the means for all trees receiving phosphorus or potassium were not significantly different from the means for all trees receiving no phosphorus or no potassium.

The weights of prunings removed annually were a reflection of annual growth since an estimated one-third of the previous season's growth was removed each winter. Every year, as shown in tables 5 and 6, the mean weights of prunings removed per tree for all trees receiving nitrogen fertilizers were larger than for trees which received no nitrogen fertilizer. These differences were highly significant for every year except one at one location.

The cumulative totals for the wood removed to the end of the experiment in both orchards showed significant differences between check plots and every plot which received nitrogen (N, NP, NK, NPK). The trees fertilized with NPK had about twice as much wood removed as the check trees in each orchard.

The phosphorus and potassium fertilizers had no apparent influence on weight of wood removed. There were no differences in the means for the cumulative totals for wood removed.

Photographs were made of individual trees from plots of each ferttilizer treat-

Table 1. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on the height and width of Sullivans Early Elberta peach trees set in 1946 at Crystal Springs, Mississippi.

Treatment	Height in feet			Width in feet		
	1950	1952	1954	1950	1952	1954
Nitrogen	10.4	12.2	10.7	13.1	15.6	15.5
Phosphorus	8.4	10.2	10.1	10.6	13.7	13.7
Potassium	8.7	10.5	9.6	10.2	12.1	13.5
Nitrogen, phosphorus	10.0	11.7	10.5	13.0	16.1	16.3
Nitrogen, potassium	10.7	11.4	10.3	12.6	14.5	15.8
Phosphorus, potassium	9.1	11.2	10.1	11.7	13.5	14.0
Nitrogen, phosphorus, potassium	11.1	12.1	11.8	14.0	15.4	16.7
Check	8.1	10.2	9.3	11.2	12.5	12.1
L.S.D. .05	1.57	1.78	1.18	2.77	2.56	2.54
.01	2.13	2.43	1.60	3.76	3.48	3.45
Summary of means for all trees receiving each fertilizer element						
Nitrogen	10.6**	11.9**	10.9**	13.2**	15.4**	16.1**
No nitrogen	8.6	10.5	9.8	10.9	13.0	13.3
Phosphorus	9.7	11.3	10.7	12.3	14.7	15.2
No Phosphorus	9.5	11.1	10.0	11.8	13.7	14.2
Potassium	10.0	11.3	10.5	12.1	13.9	15.0
No potassium	9.2	11.1	10.2	12.0	14.5	14.4

*Significant at .05 level.

**Significant at .01 level.

Table 2. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on the height and width of Sullivans Early Elberta peach trees set in 1946 at Holly Springs, Mississippi.

Treatment	Height in feet			Width in feet		
	1951	1953	1955	1951	1953	1955
Nitrogen	11.7	12.5	14.1	14.2	15.5	18.0
Phosphorus	8.3	9.0	9.4	9.5	9.9	10.7
Potassium	10.0	11.2	12.4	12.3	13.4	12.7
Nitrogen, phosphorus	10.7	12.3	14.2	15.4	16.0	20.1
Nitrogen, potassium	11.7	12.0	12.9	13.3	17.2	18.0
Phosphorus, potassium	9.2	9.5	9.6	12.1	12.5	13.4
Nitrogen, phosphorus, potassium	11.5	12.5	14.5	15.5	17.6	19.9
Check	9.5	10.6	11.5	12.2	13.0	13.0
LS.D. .05	1.25	1.48	1.85	2.01	2.23	2.60
.01	1.70	2.01	2.52	2.74	3.03	3.54
Summary of means for all trees receiving each fertilizer element						
Nitrogen	11.4**	12.3**	13.9**	15.2**	16.6**	19.0**
No nitrogen	9.3	10.1	10.7	12.5	12.2	12.5
Phosphorus	9.9*	10.8*	11.9	14.1	14.0	16.0
No phosphorus	10.8	11.6	12.7	13.6	14.8	15.5
Potassium	10.6	11.3	12.3	14.8*	15.2**	16.0
No potassium	10.1	11.1	12.3	12.9	13.6	15.5

*Significant at .05 level.

**Significant at .01 level.

ment in the Holly Springs orchard on July 24, 1952. Each photograph was made at 25 feet from the tree trunk. These large differences in size between trees of various fertilizer treatments can be seen in figures 3 to 6.

Yields

Yields in both orchards were adversely affected by unfavorable weather during several years.

Prolonged dormancy, which resulted from inadequate cold weather prior to

Table 3. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on the trunk circumference (inches) of Sullivans Early Elberta peach trees set in 1946 at Crystal Springs, Mississippi.

Treatment	1948	1950	1952	1954
Nitrogen, phosphorus, potassium	10.0	17.4	20.9	21.3
Nitrogen	9.7	16.4	20.3	21.4
Phosphorus	9.4	14.6	18.2	19.2
Potassium	8.2	12.9	17.2	17.9
Nitrogen, Phosphorus	9.4	15.6	19.6	20.8
Nitrogen, Potassium	9.4	16.2	18.6	19.4
Phosphorus, Potassium	9.6	15.4	18.3	19.7
Nitrogen, Phosphorus, Potassium	10.4	17.4	20.9	21.3
Check	8.6	14.0	18.4	18.6
L.S.D. .05	2.19	3.40	3.25	3.83
.01	2.97	4.63	4.42	5.20
Summary of means for all trees receiving each fertilizer element				
Nitrogen	9.7	16.4*	19.8*	20.7
No Nitrogen	8.9	14.2	18.0	18.9
Phosphorus	9.7	15.7	19.2	20.3
No Phosphorus	8.9	14.9	18.6	19.3
Potassium	9.4	15.5	18.7	19.6
No Potassium	9.2	15.1	19.1	20.0

*Significant at .05 level.
**Significant at .01 level.

Table 4. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on the trunk circumference (inches) of Sullivans Early Elberta peach trees set in 1946 at Holly Springs, Mississippi.

Treatment	1950	1952	1954	1956
Nitrogen	14.2	17.8	21.9	24.2
Phosphorus	10.5	13.4	16.0	17.1
Potassium	12.8	16.6	19.3	20.7
Nitrogen, phosphorus	13.2	17.9	22.5	24.4
Nitrogen, potassium	14.1	17.7	21.8	24.1
Phosphorus, potassium	11.8	15.5	18.5	20.2
Nitrogen, phosphorus, potassium	14.6	19.7	24.4	26.4
Check	12.2	15.8	18.6	20.0
L.S.D. .05	2.27	2.99	3.35	3.32
.01	3.09	4.08	4.55	4.52
Summary of means for all trees receiving each fertilizer element				
Nitrogen	14.0**	18.3**	22.6**	24.7**
No nitrogen	11.8	15.3	18.1	19.6
Phosphorus	12.5	16.6	20.3	22.0
No phosphorus	13.3	17.0	20.4	22.3
Potassium	13.3	17.3	21.0	22.8
No potassium	12.5	16.3	19.7	21.5

*Significant at .05 level.
**Significant at .01 level.

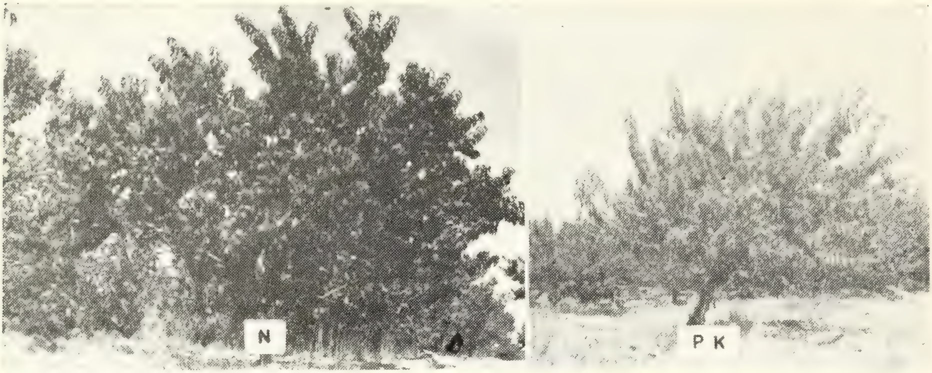

Figure 3. Six-year-old Sullivans Early Elberta peach trees at Holly Springs, Mississippi, which had received annual applications of nitrogen and phosphorus plus potassium fertilizers respectively. Photographs were made at 25 feet from the tree trunks and contact prints used.

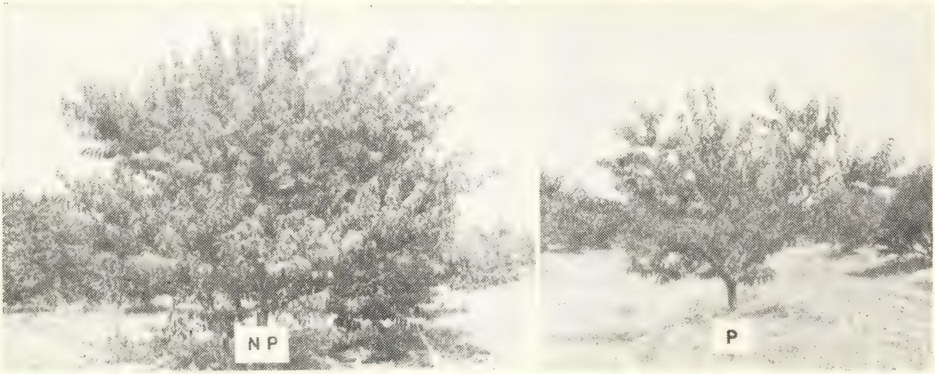

Figure 4. Six-year-old Sullivans Early Elberta peach trees at Holly Springs, Mississippi, which had received annual applications of nitrogen plus phorsphorus and phosphorus fertilizers respectively. Photographs were made at 25 feet from the tree trunks and contact prints used.

February 15, was responsible for three crop failures at Crystal Springs. These winters were 1948-49, 1949-50 and 1951-52. The Sullivans Early Elberta variety has a somewhat high chilling requirement to break the rest period. Unless about 950 hours of temperatures below 46°F occur before mid-February there will be no fruit. Furthermore, the trees may be 4 to 6 weeks later than normal to leaf-out and even then make uneven growth.

Late winter and early spring freezing temperatures were responsible for crop failures in the orchard at Holly Springs. Crop failures in 1949, 1950 and 1951 were due to spring freezes and the low yield in 1954 was due to temperatures of 22°F in the orchard at full bloom in mid-March.

A serious freeze on March 28, 1955, after the trees had bloomed and leafed out, resulted in a total crop failure for all orchards in Mississippi. Some wood injury was also sustained by the trees.

The yield data from the Crystal Springs orchard are given in Table 7 and yields for the Holly Springs orchard are shown

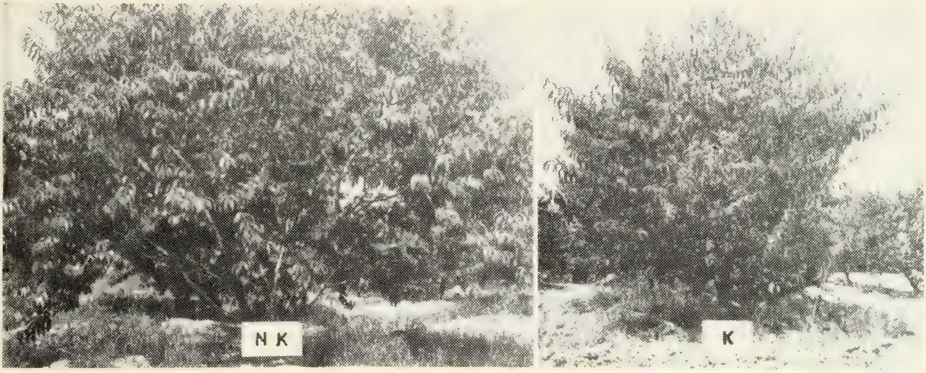

Figure 5. Six-year-old Sullivans Early Elberta peach trees at Holly Springs, Mississippi, which had received annual applications of nitrogen plus potassium and potassium fertilizers respectively. Photographs were made 25 feet from the tree trunks and contact prints used.

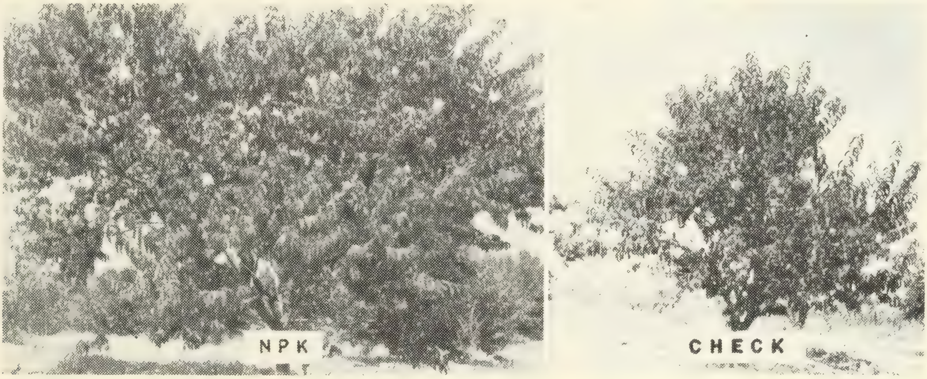

Figure 6. Six-year-old Sullivans Early Elberta peach trees at Holly Springs, Mississippi, which had received annual applications of nitrogen plus phosphorus plus potassium and no fertilizers (check) respectively. Photographs were made at 25 feet from the tree trunks and contact prints used.

in Table 8. In both orchards the most pronounced increases in yields were produced by nitrogen fertilizer when used alone or in combination with phosphorus or potassium or both.

The NPK plots at both Crystal Springs and Holly Springs produced significantly larger yields than the check plots which received no fertilizer. The cumulative total yields of all fruits produced in each orchard by trees receiving NPK were about three times as large as the yields from check trees which received no fertilizer.

When the summary of mean yield for all trees receiving nitrogen was compared with the mean yield of all trees receiving no nitrogen, the nitrogen means were substantially larger in all cases. This indicates that nitrogen is the most important fertilizer element to use for increasing yields, as well as tree size.

The response from the use of phosphorus and potassium fertilizers was much less pronounced. In the Crystal Springs orchard both phosphorus and potassium

Table 5. The influence of annual application of nitrogen, phosphorus and potassium fertilizers on the weight of prunings (pounds) removed from Sullivans Early Elberta peach trees set in 1946 at Crystal Springs, Mississippi. The trees were annually pruned moderately (25 to 50 % of the previous season's growth was removed).

					Total
Treatment	1948	1950	1952	1954	1948-1954
Nitrogen	4.3	7.2	21.2	18.0	85.8
Phosphorus	3.1	5.7	6.5	12.7	48.8
Potassium	2.1	4.4	7.7	10.2	42.8
Nitrogen, phosphorus	3.8	7.3	11.0	21.2	79.2
Nitrogen, potassium	4.2	9.7	9.0	21.1	81.5
Phosphorus, potassium	2.5	6.2	7.5	14.9	55.0
Nitrogen, phosphorus, potassium	4.5	8.3	11.5	26.7	96.0
Check	3.1	8.9	6.5	9.7	47.2
L.S.D. .05	1.99	3.99	6.71	7.17	25.75
.01	2.70	5.43	9.13	9.76	35.04
Summary of means for all trees receiving each fertilizer element					
Nitrogen	4.2**	8.1	13.2**	21.8**	85.7**
No nitrogen	2.7	6.3	7.0	11.9	48.5
Phosphorus	3.5	6.9	9.1	18.9*	69.8
No phosphorus	3.4	7.5	11.1	14.8	64.4
Potassium	3.3	7.1	8.9	18.3	68.9
No potassium	3.6	7.3	11.3	15.4	65.3

*Significant at .05 level.
**Significant at .01 level.

Table 6. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on the weight of prunings (pounds) removed from Sullivan's Early Elberta peach trees set in 1946 at Holly Springs, Mississippi. The trees were annually pruned moderately (25 to 50% of the previous season's shoot growth was removed).

					Total
	1949	1951	1953	1955	1947-1955
Nitrogen	7.4	10.1	14.0	25.6	96.9
Phosphorus	2.7	2.4	4.4	7.7	30.5
Potassium	4.1	6.5	10.6	14.6	67.6
Nitrogen, phosphorus	6.2	8.2	14.0	20.2	103.7
Nitrogen, potassium	7.3	13.2	12.6	21.1	102.0
Phosphorus, potassium	4.9	6.6	6.4	11.0	50.8
Nitrogen, phosphorus, potassium	8.2	13.7	23.1	19.6	113.7
Check	5.1	6.5	8.6	9.1	55.1
L.S.D. .05	2.50	4.23	7.25	6.32	24.85
.01	3.40	5.75	9.87	8.60	33.82
Summary of means for all trees receiving each fertilizer element					
Nitrogen	7.3**	11.3**	16.0**	21.7**	103.9**
No nitrogen	4.2	5.5	7.5	10.6	50.9
Phosphorus	5.5	7.7	12.0	14.7	74.6
No phosphorus	6.0	9.1	11.5	17.6	80.2
Potassium	6.2	10.0**	13.2	16.6	83.4
No potassium	5.3	6.8	10.3	15.7	71.4

*Significant at .05 level.
**Significant at .01 level.

significantly improved the yields as shown by the means for the cumulative totals. At Holly Springs only potassium improved the yields, as shown by the means for yields of all trees receiving potassium fertilizer, as compared to no potassium fertilizer.

Earliness of ripening is sometimes quite important, but generally high yields are more important. Nitrogen fertilizer stimulates vegetative growth and the resulting young developing leaves and shoots compete with the fruits for the available carbohydrates which are manufactured by the mature leaves. This causes a delay in maturity. In general, the length of delay in maturity is directly related to the rate of nitrogen fertilizer used. Figure 7 shows fruits on a check (no fertilizer) tree which had inadequate foliage in the NPK experiment. The scarcity of leaves may be attributed to low nitrogen in the tree which resulted from the lack of nitrogen fertilizers.

In these experiments the first two harvest dates were considered early and the yield for those dates was calculated as the percent of the total yield and was called "earliness". Table 9 presents the data from Holly Springs. The most outstanding result is shown by the earlier ripening on trees which received no nitrogen fertilizer. All plots receiving nitrogen fertilizer were significantly later to ripen than plots receiving no nitrogen when the cumulative averages are considered.

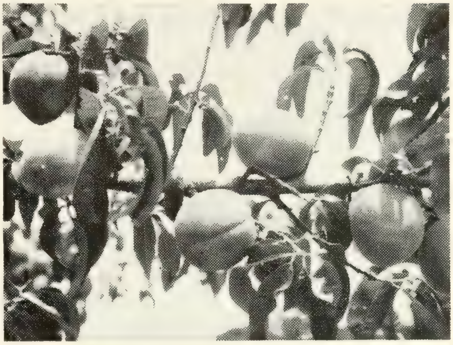

Figure 7. Sullivans Early Elberta peach fruits on a check tree showing sparse foliage typical of trees receiving no fertilizer.

Table 7. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on total yield (pounds per tree) from Sullivans Early Elberta peach trees at Crystal Springs, Mississippi.

Treatment	1951	1953	1954	Total
Nitrogen	132.5	88.5	103.5	324.5
Phosphorus	76.0	95.5	58.5	230.0
Potassium	71.8	75.7	49.5	196.7
Nitrogen, phosphorus	119.9	104.2	93.3	317.4
Nitrogen, potassium	170.0	89.0	83.0	342.0
Phosphorus, potassium	94.2	94.5	56.2	244.9
Nitrogen, phosphorus, potassium	212.1	108.0	124.5	444.6
Check	50.8	63.0	38.3	152.1
L.S.D. .05	74.38	42.27	27.71	145.66
.01	101.24	57.53	37.71	198.25
Summary of means for all trees receiving each fertilizer element				
Nitrogen	158.7**	97.4	101.1**	357.2**
No nitrogen	73.2	82.2	50.6	206.0
Phosphorus	125.6	100.6*	83.1	309.3*
No phosphorus	106.3	79.0	68.6	253.9
Potassium	137.1*	91.8	78.3	307.2*
No potassium	94.8	87.8	73.4	256.0

*Significant at .05 level.
**Significant at .01 level.

Table 8. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on total yields (pounds) per tree from Sullivans Early Elberta peach trees at Holly Springs, Mississippi.

Treatment	1952	1953	1954	1956	Total
Nitrogen	78.2	142.8	6.6	205.7	433.3
Phosphorus	15.8	36.0	1.2	40.2	93.2
Potassium	43.9	68.3	2.4	95.0	209.6
Nitrogen, phosphorus	77.0	116.5	30.8	174.5	398.8
Nitrogen, potassium	87.8	105.3	6.2	264.2	463.5
Phosphorus, potassium	36.3	53.8	3.6	63.7	157.4
Nitrogen, phosphorus, potassium	97.2	130.8	35.4	277.5	540.9
Check	38.9	57.0	1.7	82.7	180.3
L.S.D. .05	34.26	51.04	22.11	61.78	105.02
.01	46.63	69.47	30.09	84.08	142.94
Summary of means for all trees receiving each fertilizer element					
Nitrogen	85.1**	123.8**	19.8**	230.5**	459.1**
No nitrogen	33.7	53.7	2.3	70.4	160.2
Phosphorus	56.6	84.2	17.8*	139.0	297.6
No phosphorus	62.2	93.3	4.3	161.9	321.7
Potassium	66.3*	89.5	12.0	175.1**	342.9*
No potassium	52.5	88.0	10.1	125.8	276.4

*Significant at .05 level.
**Significant at .01 level.

Table 9. The influence of annual applications of nitrogen, phosphorus and potassium fertilizers on earliness (expressed as percent) of ripening of fruit of Sullivans Early Elberta peach trees at Holly Springs, Mississippi.

Treatment	1952	1953	1956	Average
Nitrogen	26.6*	27.3**	8.7*	20.9**
Phosphorus	64.5	95.7	27.8	62.7
Potassium	43.7	66.0	51.9	53.9
Nitrogen, phosphorus	31.8*	28.6**	23.8	31.4**
Nitrogen, potassium	8.1**	23.3**	4.1**	11.8**
Phosphorus, potassium	47.8	65.2	46.4	53.1
Nitrogen, phosphorus, potassium	24.6**	11.5**	25.3	20.5**
Check	56.6	85.6	51.5	64.6
Statistical comparisons are between the check and other treatments				
Summary of means for all trees receiving each fertilizer element				
Nitrogen	22.8**	22.7**	15.5**	21.1**
No nitrogen	53.1	78.1	44.3	58.6
Phosphorus	42.2	50.2	30.8	41.9
No phosphorus	33.7	50.6	29.0	37.8
Potassium	31.1*	41.5	31.9	34.8
No potassium	44.8	59.3	27.9	44.9

*Significant at .05 level.
**Significant at .01 level.

Results of Pruning and NPK Rates Experiment

This experiment was begun in spring of 1950 with three levels of pruning severity and two rates of NPK. At the beginning of this experiment the trees had been in the orchards four years and had reached bearing age.

The extremes of severity used in this experiment did not result in any significant differences in height of trees at the end of six years of experimental pruning as shown in Table 10. Tree width was significantly decreased by heavy pruning treatments at each of the NPK rates used in this experiment.

The reason that differences in tree height, width and trunk circumferences (Tables 10 and 11) were influenced so slightly by these pruning levels is that, with the high fertility levels maintained, the severe pruning treatment resulted in larger and longer shoots than the medium and light treatments. This added length tended to compensate for loss of size resulting from the greater severity of pruning.

The degree of severity of pruning resulted in very large differences in the amount of prunings removed. Differences in the wood removed from mature trees may be seen in Figure 8 where light pruning removed 5.5 pounds, medium pruning removed 11.0 pounds, and heavy pruning removed 16.0 pounds. These large differences may be noted for individual years as shown in Table 12, and for the cumulative totals for the duration of the experiment. These totals were 32.5 pounds of wood removed per tree for the light pruned trees, 106.0 pounds per tree for the medium pruned, and 141.1 pounds per tree for the heavy pruned trees.

There was no difference in the pounds of prunings removed from trees fertilized at the NPK and 2(NPK) rate. This fact indicates that the 2(NPK) rate was an excessive or luxury application and that the NPK rate (6 pounds 16 percent nitrogen, 6 pounds 20 percent superphosphate, and 1½ pounds 50 percent muriate of potash annually when the trees were

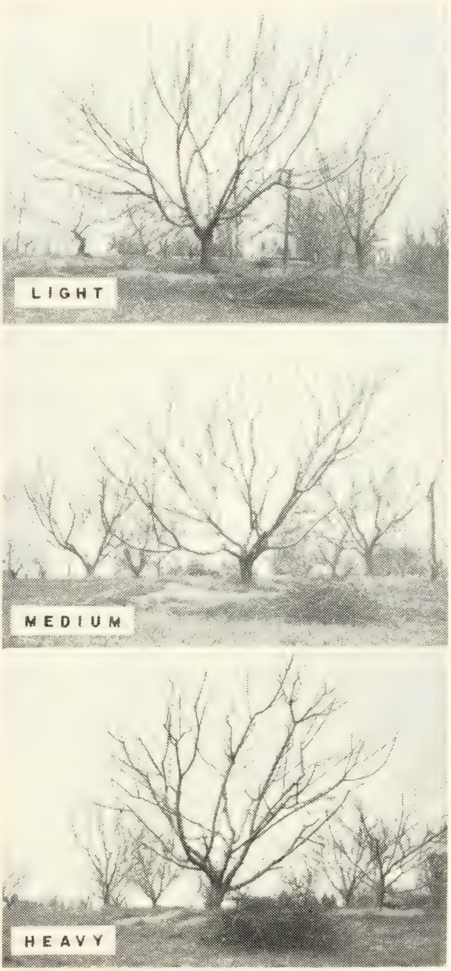

Figure 8. Six-year-old peach trees pruned to three levels of severity. Light, 5.5 pounds of prunings removed. Medium, 11.0 pounds of prunings removed. Heavy, 16.0 pounds of prunings removed.

six or more years old) was sufficient to promote maximum tree growth under the conditions of the experiment.

The trees which were pruned lightly produced significantly larger yields every crop season except 1954, than those pruned heavily as shown in Table 13. As stated previously, the yields that year were severely reduced by a mid-March freeze of 22°F during the time the trees were in full bloom. The cumulative total for all trees in the light pruned plots was about 50 percent larger than the yield from trees in the heavy pruned plots.

Table 10. The influence of three levels of pruning severity and two rates of NPK fertilizer application on height and width of Sullivans Early Elberta peach trees set in 1946 at Holly Springs, Mississippi

Treatment		Height in feet			Width in feet		
Pruning	Fertilizer	1951	1953	1955	1951	1953	1955
Light	NPK	11.2	12.7	14.0	15.0	17.2	20.4
Light	2(NPK)	11.6	12.1	13.4	15.2	18.3	21.0
Medium	NPK	11.5	12.5	14.5	15.5	17.6	19.9
Medium	2(NPK)	11.9	12.6	14.1	13.8	15.9	18.9
Heavy	NPK	11.2	12.9	13.9	14.4	16.7	18.5
Heavy	2(NPK)	11.5	12.6	14.6	14.7	17.5	18.0
L.S.D. .05		2.02	1.78	1.85	3.48	2.89	3.26
.01		2.80	2.46	2.56	4.81	3.99	4.50
Summary of means for all trees receiving each pruning treatment							
Light		10.9	12.4	13.7	15.1	17.8	20.7
Medium		11.2	12.6	14.3	14.7	16.7	19.4
Heavy		11.3	12.7	14.2	14.5	17.1	18.2
L.S.D. .05		1.43	1.26	1.31	2.46	2.04	2.30
.01		1.98	1.74	1.81	3.40	2.82	3.18
Summary of means for all trees receiving each fertilizer treatment							
NPK		11.3	12.7	14.1	15.0	17.2	19.6
2(NPK)		11.0ns	12.5ns	14.0ns	14.6ns	17.2ns	19.3ns

ns—Not Significant

Table 11. The influence of three levels of pruning severity and two rates of NPK fertilizer application on the trunk circumference (inches) of Sullivans Early Elberta peach trees set in 1946 at Holly Springs, Mississippi.

Treatment					
Pruning	Fertilizer	1949	1951	1953	1955
Light	NPK	11.0	16.5	19.6	24.3
Light	2(NPK)	11.1	17.0	19.4	22.8
Medium	NPK	11.6	17.7	22.2	25.4
Medium	2(NPK)	11.0	16.6	20.4	25.1
Heavy	NPK	10.9	16.4	20.0	24.5
Heavy	2(NPK)	10.3	15.7	19.7	23.5
L.S.D. .05		2.85	3.61	3.61	3.17
.01		3.94	4.99	4.99	4.38
Summary of means for all trees receiving pruning treatment					
Light		11.0	16.7	19.5	23.5
Medium		11.3	17.2	21.3	25.2
Heavy		10.6	16.0	19.9	24.0
L.S.D. .05		2.02	2.55	2.55	2.24
.01		2.79	3.53	3.55	3.10
Summary of means for all trees receiving each fertilizer treatment					
NPK		11.2	16.9	20.6	24.7
2(NPK)		10.8ns	16.4ns	19.8ns	23.8ns

ns—Not Significant

There were no differences in yield between the NPK and 2(NPK) plots. This is further evidence that the NPK rate was sufficient to produce the maximum yields in this orchard.

In general, the response to medium pruning was intermediate between light and heavy pruning. New shoot growth was not quite as vigorous as shoots on heavy pruned trees. Yields from medium pruned trees were also intermediate, but they were closer to the yields from heavy

Table 12. The influence of three levels of pruning severity and two levels of NPK fertilizer application on the weight of prunings (pounds) removed annually from Sullivans Early Elberta peach trees set in February of 1946 at Holly Springs, Mississippi. The dates represent the years growth which was pruned.

Treatment						Total
Pruning	Fertilizer	1949	1951	1953	1955	1949-1955
Light	NPK	0	1.2	6.1	7.0	27.9
Light	2(NPK)	0	3.1	3.4	10.5	36.9
Medium	NPK	8.2	13.7	23.1	19.6	111.7
Medium	2(NPK)	4.2	9.9	25.1	18.1	100.1
Heavy	NPK	7.8	18.1	24.2	26.4	140.4
Heavy	2(NPK)	6.7	15.9	29.7	27.4	141.5
L.S.D. .05		2.70	5.72	8.27	10.20	27.49
.01		3.73	7.92	11.44	14.11	38.02
Summary of means for all trees receiving pruning treatment						
Light		0	2.1	4.7	8.7	32.5
Medium		6.2	11.8	24.1	18.9	106.0
Heavy		7.3	15.1	27.0	27.0	141.1
L.S.D. .05		1.91	4.05	5.85	7.22	19.44
.01		2.64	5.60	8.09	9.98	26.88
Summary of means for all trees receiving each fertilizer treatment						
NPK		5.3	11.0	17.8	17.7	93.5
2(NPK)		3.6ns	9.6ns	19.4ns	18.7ns	92.9ns

ns—Not Significant

Table 13. The influence of three levels of pruning severity and two levels of NPK application on the yield (pounds) per tree from Sullivans Early Elberta peach trees set in 1946 at Holly Springs, Mississippi.

Treatment						
Pruning	Fertilizer	1952	1953	1954	1956	Total
Light	NPK	108.2	186.7	21.7	330.2	647.0
Light	2(NPK)	99.0	123.0	23.7	361.2	607.0
Medium	NPK	97.0	130.7	30.5	277.5	535.7
Medium	2(NPK)	58.7	126.7	9.0	239.5	434.0
Heavy	NPK	58.2	109.5	28.7	188.2	384.7
Heavy	2(NPK)	76.7	96.2	40.7	249.7	463.0
L.S.D. .05		5.30	7.49	4.38	7.37	167.52
.01		7.33	10.35	6.06	10.20	231.66
Summary of means for all trees receiving each pruning treatment						
Light		103.6	154.9	22.7	345.7	626.9
Medium		77.9	128.7	19.7	258.5	484.8
Heavy		67.5	102.9	34.7	218.7	423.8
L.S.D. .05		3.75	5.29	3.10	5.21	118.46
.01		5.19	7.32	4.29	7.21	163.82
Summary of means for all trees receiving each fertilizer treatment						
NPK		87.8	142.3	27.0	265.3	522.4
2(NPK)		78.2ns	115.3ns	24.5ns	283.3ns	501.3ns

ns—Not Significant

Table 14. The influence of three levels of pruning severity and two rates of NPK fertilizer application on earliness of ripening of Sullivans Early Elberta peach trees set in 1946 at Holly Springs, Mississippi.

Treatment		Earliness in percent			
Pruning	Fertilizer	1952	1953	1956	Average
Light	NPK	52.1	35.3	25.0	37.5
Light	2(NPK)	57.4	33.9	5.2	32.2
Medium	NPK	38.0	11.5	25.4	25.0
Medium	2(NPK)	38.8	22.1	10.9	23.9
Heavy	NPK	11.9	27.1	8.1	15.7
Heavy	2(NPK)	27.6	19.8	4.8	17.4
Summary of means for all trees receiving each pruning treatment					
Light		54.7	34.6	15.1	34.8
Medium		38.4ns	16.8ns	18.1ns	25.5
Heavy		19.7**	23.4ns	6.4ns	16.5*
Summary of means for all trees receiving each fertilizer treatment					
NPK		34.0	24.6	26.2	28.3
2(NPK)		41.3ns	25.3ns	7.0ns	24.5ns

*Significant at .05 level.
**Significant at .01 level.
ns Not Significant.

pruned trees than to light pruned trees. The heavy pruning treatment resulted in longer shoot growth early in the season. This shoot growth competed with the growing fruits for carbohydrates. This competition in heavy pruned trees resulted in later ripening than in the light pruned trees where the competition for carbohydrates between fruits and new shoots was less severe. About twice as much fruit matured early in the ripening season on light pruned trees as compared to heavy pruned trees (Table 14).

Discussion

The influence of nitrogen was the most pronounced as shown in the results of the NPK fertilizer element experiment. A constant supply of readily available nitrogen is necessary to support good tree growth and adequate yields. The total yield of trees in the nitrogen fertilizer plots was almost three times the total yield of the trees in the plots which received no nitrogen. Even more pronounced results might be expected from nitrogen applications, if an orchard were located on a more sandy type of soil.

Peach growers can expect increased tree growth and yield from nitrogen applications on most of the soil types in this state. In general, peach orchards are located on hillsides which have been subject to much leaching of nitrogen from the soil. They are therefore, responsive to nitrogen applications because the nitrogen supplying capacity of the low organic matter content of these soils is low. Row crops such as cotton or corn respond favorably to nitrogen fertilizer applications on most soil types in Mississippi, and their need for nitrogen in plant growth is not markedly greater than the need for nitrogen by peaches.

The failure of the phosphorus or potassium fertilizers to improve gross tree size is indicative that these soils have a fairly large amount of these exchangeable nutrient elements. Even though phosphorus and potassium did not give the large increments of increase which resulted from nitrogen applications, there were distinct improvements in yield. The fact that yields were increased by phosphorus and potassium fertilizers indicates that the trees were able to utilize larger amounts of these elements than were readily available in the soil.

The plots receiving the three major fertilizer elements made the largest trees and produced more fruit than the other plots. In a number of instances trees in the NPK plots were the only ones significantly larger than the check.

Nitrogen fertilizer at the rate of 6 pounds of 16 percent nitrogen for mature trees caused the fruits to ripen later than fruit on those trees which received no nitrogen fertilizer. This was true even though one-third of the nitrogen was withheld until the fruits were mature. Thus, in case a grower considers the delay in ripening from these nitrogen rates to be excessive, he could shorten the delay by shifting a greater portion of the application from before blossoming to that at the time of fruit harvest.

The established fact that severely pruning young peach trees results in a delay in coming into bearing should be carefully considered by peach growers. The training of peach trees should be done during the first and second summer by frequent, light summer pruning to select the frame-work and develop a desirable tree shape.

The severe reduction in yields resulting from heavy pruning indicates that growers should prune mature trees as light as possible and still maintain a suitable tree shape. The results of the pruning tests indicate that the medium pruning (which removed one-third of the previous season's growth) may be more severe than is desirable. If tree shape can be maintained with the removal annually of 10 to 25 percent of the previous season's growth, then this would result in heavier yields. More thinning would be necessary, but the additional fruit would more than compensate for this extra work.

The nitrogen rate used in the NPK test was 0.96 pound elemental nitrogen annually for a mature peach tree. These rates have been found sufficient in other peach growing areas in the southeastern United States. The phosphorus rate was 1.2 pounds P_2O_5 annually and the potassium rate was 0.75 pound K_2O annually per mature tree. The evidence from these experiments indicates that these amounts are high enough, because only moderate yield increases resulted from their application.

The advantage of using a complete (NPK) fertilizer is to supply readily available phosphorus and potassium for tree growth. Optimum tree growth will be insured by sufficient supplies of these elements, in the event they are limited in the soil.

Most of the Agricultural Experiment Stations and Extension workers in southern peach growing areas of the United States recommend annual applications of 6-8-8, 8-8-8 or similar fertilizers plus additional nitrogen fertilizers such as ammonium nitrate or nitrate of soda. One pound of these mixed fertilizers plus one-half pound of 16 percent nitrate of soda (or ¼ pound ammonium nitrate) per tree per year of age would provide about as much nitrogen as the low NPK rate used in this experiment.

Probably no other single factor in the culture or management of peach orchards could be expected to give such outstanding yield increases as the proper use of fertilizer. The NPK fertilizer application to peach trees at the single rate in these experiments resulted in three times the yield of check trees which received no fertilizer. However, a peach grower should not neglect any of the many factors so important to success such as proper varieties, fruit thinning, as well as insect and disease control.

Summary

NPK Fertilizer Experiment

Experiments were conducted with Sullivans Early Elberta peach trees at Crystal Springs and Holly Springs, Mississippi to determine the influence of the fertilizer elements nitrogen (N), phophorus (P), and potassium (K), on tree growth and fruit production.

The fertilizer rates per tree per year of age to six years were: nitrogen, one pound 16 percent nitrogen or ½ pound 33 percent nitrogen; phosphorus, one pound 20 percent superphosphate; and potassium, ¼ pound 50 percent muriate of potash. After six years of age the six-year-rate was continued annually.

Nitrogen fertilizer resulted in increased tree size as indicated by tree height, width, trunk circumference and weight of prunings removed. This increase was obtained whether nitrogen was used alone or in combination with phosphorus or potassium or both.

Tree growth as measured by tree height, width, trunk circumference or weight of prunings removed was not significantly improved by either phosphorus or potassium fertilizers.

Trees receiving NPK fertilizers produced about three times as much fruit as trees which received no fertilizer.

Potassium fertilizer increased the yield of fruit in the orchards at both Crystal Springs and Holly Springs.

Phosphorus fertilizer increased total yield of fruit in the orchard at Crystal Springs.

Fruit on trees that received nitrogen fertilizer were later in maturing than fruit on trees which received no nitrogen fertilizer.

Pruning and NPK Rates Experiment

This experiment was conducted to determine the influence of three levels of pruning severity and two rates of NPK application on mature Sullivans Early Elberta peach trees at Holly Springs, Mississippi.

The three levels of pruning were: light, removing only crossed, interfering or broken limbs; medium, removing about one-third of previous season's growth; and heavy, removing about two-thirds of previous season's growth. The cumulative totals of wood removed per tree after 7 years were: light, 32.5 pounds; medium, 106.0 pounds; and heavy, 141.1 pounds per tree.

Two rates of NPK application were used at each level of pruning severity. The low NPK rate was the same as used in the NPK fertilizer experiments as noted in paragraph two of the Summary. The 2(NPK) rate was twice as much of each fertilizer material per tree.

Tree height and trunk circumference were not significantly influenced by the three levels of pruning severity tested.

Heavy pruning significantly reduced tree size as indicated by width of tree.

The 2(NPK) rate did not increase the tree size or yield over the NPK rate at any level of pruning severity.

Heavy pruning significantly reduced the yield of peaches as compared to light pruning.

Heavy pruning caused a delay in maturation of the fruit.

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BULLETIN 597 MAY, 1960

Community Development Clubs
IN
ALCORN COUNTY, MISSISSIPPI

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SUMMARY

1. In recent years there has been a growing interest in rural development as a means to help improve agricultural production and standards of living. There are about 450 rural community development clubs in Mississippi and 2,000 in the Southeast. This bulletin describes the community development clubs in Alcorn County, Mississippi, during the period 1954 through 1958.

2. The first community development club in Alcorn County was organized in 1952 through the efforts of county leaders. By the end of 1956, ten more communities had asked for assistance in organizing clubs. The clubs were at first most concerned with organizational problems and short range goals and gradually shifted to long range community development goals.

3. The Alcorn County Development Council, composed of representatives from agricultural agencies, Corinth civic clubs, and club members, was the coordinating group. Each club had its own officers. Over three-fourths of the club meetings had educational programs. About half of the educational programs were on agriculture, a third on the community, and the remainder on homemaking. The county goals were printed in the annual contest score card. Each club established goals based on the county goals.

4. A community club is an example of people doing things together. The club members were regular in attendance. However, only one in four took part in the discussion during club meetings. Only 20 percent of the families in the club communities were members. The club membership seemed to be representative of the occupational groups. On the other hand, the club members ranked higher than non-club members in most measures of socio-economic status.

5. The functions performed by community development clubs may be divided into two categories, (a) the formally stated purposes of the clubs and (b) the informal functions occuring as a result of the operation of the clubs. The formal functions were community development, improvement of town and country relations, an educational media, and community cohesion. The informal functions were a change agent, action facilitation, community identity, assumption of functions, an intermediate or catalytic agent, community survival, leadership training, and compulsion for conformity.

COMMUNITY DEVELOPMENT CLUBS
IN
ALCORN COUNTY, MISSISSIPPI

By **ANDREW W. BAIRD** and **WILFRID C. BAILEY***

I. INTRODUCTION

In recent years there has been a growing interest in rural development as a means to help improve agricultural production and standards of living. The Department of Agriculture has pointed out that trade area programs and community development programs have been effective in increasing incomes and raising levels of living. One of its recommendations was that farm, business, and other leadership should assume local responsibility and unite in efforts to develop agriculture's human resources.

A community development program may be defined as an organized activity with multiple interests and objectives which is operated in a delineated geographic area and is all inclusive as to participants and beneficiaries. In terms of emphasis and organizational features, community development programs in the Southeast may be classified into three types. One type, which might be termed individual grass roots programs, has no organizational stimulation from the outside and depends entirely on local leadership. A second type emphasizes a survey and study group approach. The third, and most extensive type, found in both rural and urban areas, is characterized by business sponsorship and contest features.[1]

Community development usually involves the work of a local organization. There are primarily two types of such organizations. (1) membership organizations or clubs and (2) committees. A community development club can be defined as a membership organization having regularly scheduled meetings, elected officers, and a planned program. This bulletin is concerned with the membership or club type of organization.

As early as 1923 the Agricultural Extension Service was promoting community development in Mississippi. During the period from 1923 to 1926 approximately 45 open county communities were organized. The movement at that early date had essentially the same characteristics as today's. The present-day movement in community development began in 1946. At this time the Community Development Foundation in Tupelo, Mississippi, began sponsoring community development in the rural area. Awards were offered to communities showing the most progress for the year. The Tupelo type program spread to other counties and has become popular throughout the Southeast. At about the same time, the Extension Sociologist at Mississippi State University began to offer technical advice and assistance to local communities. The local Extension Agents and the Extension Sociologist encouraged the movement at the county level. Since that time there has

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*The authors wish to express their thanks for the splendid cooperation given to the project by the residents of Alcorn County. Special mention should be made of the contribution of club members and officers, Alcorn County Development Council, numerous civic minded citizens of Corinth, county Agricultural Extension Service staff, and other agricultural agency personnel. It was a pleasure to watch the community development clubs grow. Best wishes are expressed for their continued success.

The Tennessee Valley Authority cooperated with the project. Members of the staff of the Agricultural Economics Branch, Division of Agricultural Relations, were instrumental in the formation of the project and gave valuable assistance throughout. The TVA share in the project was officially known as the "Mississippi Community Fertilizer Education Experiment."

[1] Harold F. Kaufman, **Community Development Programs in the Southeast**, The Social Science Research Center Community Series No. 6; State College: Mississippi State University, 1956.

been a steady increase in the number of communities participating in the movement.[2] At the present time there are about 450 community development clubs in Mississippi and over 2,000 in the Southeast.

Alcorn County, Mississippi, is representative of the low income area covering much of the Southeast. In the 1954 Agricultural Census nearly two-fifths of the farms were classified as part-time or residential, one-fifth were commercial farms with less than $1,200 in gross sales, and only 4 percent of all farms had gross sales of over $5,000. The farm-operator level-of-living index was in 1954 slightly higher than the average for Mississippi and less than the national average a decade earlier.

About 75 percent of the cash farm income was from cotton. Corn was grown on almost as many farms as cotton but contributed little to the cash income. Livestock has been increasing in importance. Nearly 60 percent of the land is best suited for timber but this resource has been under utilized.

The county contains three distinct land-use areas. The eastern and western thirds consist of poor hilly land, best suited to timber. Running north and south through the center of the county is a belt of relatively more level land, better suited to farming. Corinth, the county seat, is located at the northern end of this belt and is the only urban center. It has attracted industry, and its population has grown to an estimated 11,000. The rest of the county contains 37 open-country communities.

In November, 1954, the Department of Sociology and Rural Life, Mississippi Agricultural Experiment Station, in cooperation with the Tennessee Valley Authority and the Alcorn County Development Council, began a study of Alcorn County. One aspect of the study was an experiment to evaluate the community development clubs as a medium for the diffusion of recommended farm and home practices.[3]

In order to determine the effectiveness of community clubs as an educational media certain questions had to be examined. What was the formal organizational structure of the community clubs? What was the interaction pattern within the clubs, between the club and the community, and between the club and the county? What functions did the clubs perform? These questions are examined in the following pages.

This bulletin discusses the community development clubs in Alcorn County during the period 1954 through 1958. It describes their organization, their activities, and their influence on community life. The effectiveness of the clubs as a means of farmer education is evaluated.

There has been no state-wide organization unifying the activities of the community development clubs in Mississippi. Most clubs participate in some sort of county program. Community development clubs in Alcorn County were representative of the sort of organization found in Mississippi and, perhaps, many other parts of the Southeast. Further, the interaction pattern and level of participation within the community development clubs is not too different than that observed in other rural organizations in Mississippi.

II. HISTORY OF CLUBS IN ALCORN COUNTY

Founding of Clubs

The community development club movement in Alcorn County began in the Spring of 1952 under the leadership and guidance of the county agent, a vice president and farm management consultant of a local bank, and the manager of a co-op. In the words of these three men, "We felt the need of this type of organization in order to fully develop the social, spiritual, and economic aspect of community life."

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[2] Raymond Payne and A. Alexander Fanelli, **Community Organization in Mississippi,** Mississippi Agricultural Experiment Station Circular 183; State College, 1953; Dorris W. Rivers and Harold F. Kaufman, **Community Development,** Mississippi Agricultural Extension Service Publication 197; State College, 1955.

[3] Wilfrid C. Bailey, **Mississippi Community Fertilizer Education Experiment: Final Report,** Preliminary Report on Sociology and Rural Life No. 7; State College: Mississippi Agricultural Experiment Station, 1959.

The proposed program was presented to the Corinth Kiwanis, Lion, and Rotary Clubs and they were asked for moral and financial support. The Kiwanis Club agreed to sponsor the first community club.

Hinkle was selected as the first community to be organized because of a strong local leadership within the community. This community was located in one of the better farming areas of the county and was considered to be one of the better rural communities.

The county agent and the bank farm consultant went to Hinkle community and personally consulted the leaders in the community on the possibilities of organizing. The leaders were interested and approximately 95 percent of the community residents were contacted on the proposed organization. Varied reactions and responses were received but most families agreed to attend a called meeting at Hinkle School to discuss the idea further.

To encourage attendance each family in the community received three different letters telling them of the first meeting. One was from the Extension office, one from the Kiwanis Club, and one from a bank. The women in the community who were members of the local Home Demonstration Club also received letters urging that they and the entire family attend.

On April 18, 1952, the first meeting was held with 67 people present. The purpose and the advantages of a community development club were explained to those present by the county agent. Two pastors of churches in the community stated that they thought the organization was just what the community needed. Several community members present at the meeting stated that they were in favor of such an organization and suggested that officers and directors be elected at this meeting. Hinkle Community Development Club, the first community club in the county, was organized that night.

The community club movement began growing in the county. Soon other communities began asking for help to organize clubs in their communities. Hinkle Club, the first to be organized in the county, was organized because of outside persuasion and influence. Eight clubs, Farmington, Gift, Holly, Kossuth, Glen, Hickory Flat, Union, and Biggersville were organized because they asked for outside help to organize. Wheeler Grove and Pleasant Hill clubs were organized when residents of these communities who had been attending the Kossuth club asked for help to organize their own.

Following is a list of all community development clubs in the county, the date of organization, place of meeting, and number of member families at the close of the 1958 club year.

Club	Date of Organization	Place of Meeting	No. of Member Families
Hinkle	April, 1952	School	23
Farmington	Feb., 1953	School	39
Gift	Feb., 1953	School	28
Kossuth	April, 1953	School	24
Holly	Mar., 1954	School	28
Wheeler Grove	May, 1954	Church	27
Glen	Oct., 1954	School	27
Pleasant Hill	Dec., 1955	Church	27
Hickory Flat	Nov., 1956	School	24
Union	Nov., 1956	School	23
Biggersville	Dec., 1956	School	45

Stages in Development

Upon close examination of the growth of community clubs two distinct cycles or stages were observed. The first stage might be called the organizational stage and the other the development stage.[4] The first was characterized by organizational problems and adjustments. Officers were elected and committees appointed, but a period of confusion and uncertainty existed. Officers and other club leaders were willing but did not know how or what to do next. In many instances they had little or no experience in organized activities such as serving as an officer of a club or helping plan community wide projects and goals. Careful planning and leadership had to be supplied from outside sources. Goals and projects initiated and carried out during this stage were usually tangible and short range, being completed within a period of one year or less.

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[4] Dorris W. Rivers, "Programming Farmer Education Through Community Clubs," in **Community Structure and Farmer Education,** Sociology and Rural Life Series No. 8; Division of Sociology and Rural Life, State College: Mississippi State University, 1957, pp. 2-6.

The second or development stage of the community club was characterized by a smoother functioning club, with long range planning, a greater variety of projects and accomplishments, and the utilization of more committees. The tangible, short range projects continued, but increasing importance was given to the long range, more intangible type of projects. Upon reaching the second stage the less interested community residents dropped from the club rolls. The educational programs dominated the activities less and placed less emphasis on farming. The club continued to serve an important social function, but many of its projects were economic in nature and directed toward raising family and community income.

Because of the gradual shift it was difficult to pin-point just when a club moved from the organizational to the development stage. However, the period of time involved for a club to make the shift varied, depending upon local leadership, and contacts a younger club had with older and more experienced clubs. The first clubs organized took about three years to grow out of the organizational stage. On the other hand, one of the last clubs to be established made the transition after one year.

III. ORGANIZATION AND PROGRAMS

The activities of the community development clubs in Alcorn County can be understood through an examination of the formal organization and the programs of the clubs carried out in club meetings and in work to achieve established goals. The formal organization was divided into two parts, the Alcorn County Development Council and the individual clubs located in the rural communities.

Formal Organization

Alcorn County Development Council

The Alcorn County Development Council was the coordinating body of the community development program

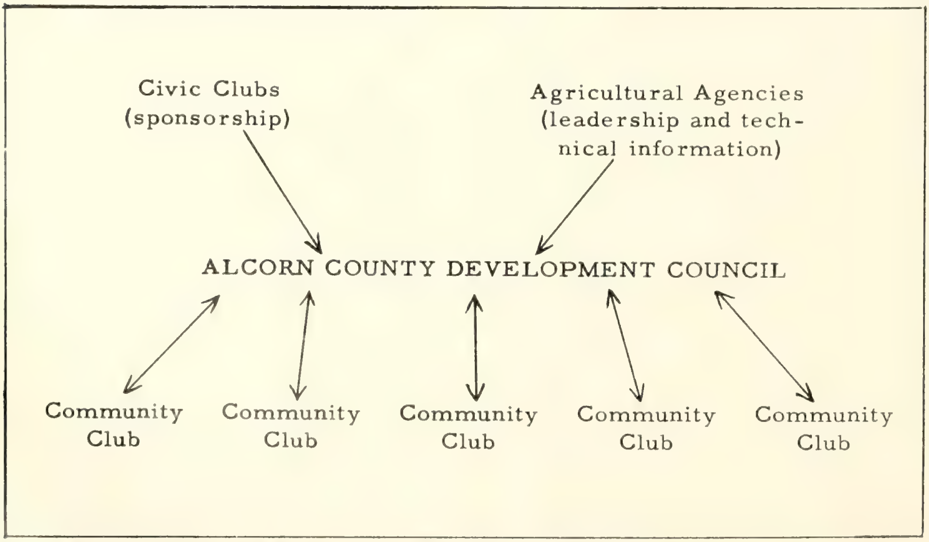

Figure 1. Organization of the Community Development Program in Alcorn County, Miss.

in the county. (Figure 1) The Council was formed to promote the economic, spiritual, and social aspects of every farm family in Alcorn County, and to bring about a closer relationship between the citizens living in Corinth and those living in the county. It was a non-sectarian, non-political, and non-profit organization.

Membership in the Council was of three classes designated as follows:

(1) Professional agricultural workers residing in and working with farmers in the county and devoting their full time to agricultural work. These people provided leadership and technical information to the individual clubs.

(2) Three representatives from each of the sponsoring civic clubs. The representatives were appointed by the sponsoring civic organizations. The civic clubs sponsored the individual clubs.

(3) Three representatives from each Alcorn County community development club. The representatives were appointed by the Board of Directors of the community clubs. Community clubs making application to be members of the Council agreed to the by-laws before being accepted as members. The acceptance of the by-laws was in writting by the secretary of the organization and was forwarded to the secretary of the Council.

The officers of the Council consisted of a president, a vice president, a secretary, a treasurer, an executive board, a nominating committee, and various other committees. The president appointed a nominating committee for Council officers at least thirty days before the meeting for election of officers. This committee reported to the Council its nominations for Council officers. Nominations from the floor were also made by Council members.

Only members duly appointed to the Council were entitled to vote on issues that arose from time to time at meetings of the Council and at elections. In case of a tie the chairman of the Council cast the deciding vote. Quarterly meetings were held regularly by the Council. Special meetings were called by the chairman or a majority of the Executive Board from time to time as needed.

Community Development Clubs

A Board of Directors acted as the governing body of each community development club. (Figure 2) Other club

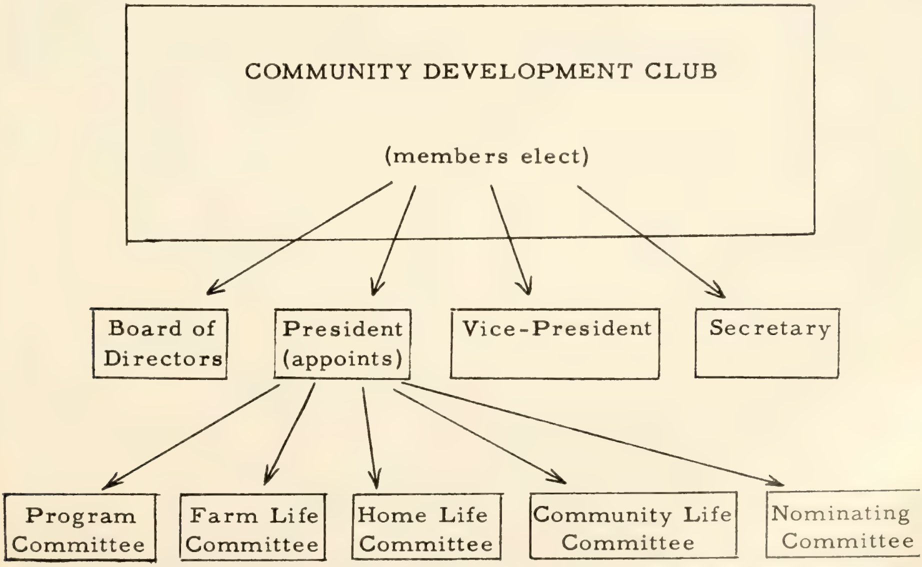

Figure 2. Organization of Community Development Clubs in Alcorn County, Mississippi.

officers consisted of a president, a vice president, secretary, and committee chairman. In addition there were several committees, the primary ones being a program committee, farm life committee, home life committee, community life committee, and nominating committee.

The president, vice president, and secretary were elected by club members. The president usually appointed the committee chairman and committee members. Sometimes, however, the president appointed a committee chairman and the chairman selected his own committee members.

The purpose of the home life, farm life and community life committees was to assume leadership in the determination of the club goals, and to initiate and assist in carrying out the projects and activities designed to realize the attainment of these goals. The program committee was responsible for planning the programs for all regular meetings of the club. It was the responsibility of the nominating committee to select a set of officers for election by the club members.

Programs and Meetings

Outline of a Typical Regular Club Meeting

All community clubs in the county followed a similar pattern as to the order of procedure of regular club meetings. The order of procedure was broken down into four major categories. These were (1) opening of the meeting, (2) business meeting, (3) club program, and (4) closing of the meeting. The average length of the club meetings studied was approximately one hour and forty-five minutes.

The president called the meeting to order. The next few minutes were devoted to group singing, followed by a short devotional. The songs were usually either religious or patriotic. The devotional consisted of a passage of scripture read from the Bible, followed by a few remarks. Someone then lead the group in a short prayer.

The second portion of the meeting consisted of the business session. At this time the minutes of the previous meeting were read and adopted, and problems and any other club business that needed attention were discussed. The types of problems generally discussed were (1) problems related to the internal functioning of the club, (2) problems of the club in relation to the Alcorn Community Development Council, (3) club goals, and (4) problems of the club in relation to other communities and agencies.

The third major portion of the meeting was the presentation of the program. This was one of the most important parts of a club meeting, because one of the surest ways of keeping a community development club alive and active was to have a well planned and properly carried out program. The interest and enthusiasm of the club members began to dwindle after a few dull programs. Community clubs were a family type organization made up of mothers, fathers, sons, and daughters. Some of the members were farmers; some part-time farmers; and some, non-farmers. Some of the farmers were dairy farmers, and some, cotton farmers. Therefore, programs were varied to interest all members.

Club programs were planned that were appropriate to the seasons of the year and to special events or holidays. A program on home gardens was more appropriate in March than in November.

Inspirational and entertainment features consisted of songs, piano music, string band music furnished by FFA boys, devotionals, comedy films, and plays and skits which were both educational and entertaining.

The closing portion of the meetings consisted of any other business that came up before the meeting adjourned, announcements, and awarding of the door prize given by the Alcorn County Development Council to boost attendance. Some clubs had a recreational period immediately after the meeting adjourned. Refreshments were sometimes served at this time.

Programs and Activities

Community development club meetings were classified into two types, regular and special. Each club in the county held regularly scheduled monthly meetings. In addition, special called meetings were held from time to time as the need arose.[5]

Although educational programs were presented at the majority of regular club meetings, this was not always the case. Therefore, regularly scheduled monthly meetings were classified into four types according to the focus of the meeting: (1) educational, (2) social, (3) organizational, (4) entertainment.

Seventy-seven percent of all regularly scheduled meetings for which information was available had educational programs. Eleven percent were socials, 6 percent were oriented toward organizational activities, and 6 percent were entertainment meetings. (Table 1). The large percentage of educational meetings may be accounted for by the fact that special meetings were usually held for the other activities or else they were taken up at the proper time during the educational meeting. Also, the clubs were used by County Extension Agents and other leaders in the county for educational purposes.

Educational Programs

An educational program may be defined as one that has as its objective the transmission of knowledge and the introduction of a change in the patterns of behavior. There were primarily three types of educational programs presented at the monthly community club meetings in Alcorn County. These were (1) agricultural programs, (2) homemaking programs, and (3) programs oriented toward the community.

As pointed out previously, educational programs were planned and presented according to seasons of the year and special events. For example, March programs presented in some clubs explained the federal cotton acreage allotment program and the various Agricultural Stablization and Conservation benefits available to farmers. April programs were on recommended practices for planting and raising cotton and corn. Insect control programs for various crops were presented in June, and in November there were programs on slaughtering and curing pork.

Forty-seven percent of all educational programs included in the sample were on agricultural subjects. Thirty-five percent were oriented toward community improvement and 18 percent were on homemaking topics. (Table 2).

The Relationship of Occupation to Type of Education Programs

Community club member families were fairly representative of the population of the communities in which clubs were found as to the occupational distribution. (Table 3). In a survey taken of the eleven communities with clubs[6] it was found that 53 percent of

Table 1. Types of regularly scheduled meetings, 1954-1958.

Type of meeting	Number	Percent
Educational	327	77
Social	46	11
Entertainment	28	6
Organizational	26	6
Total	427	100

Table 2. Summary of educational programs presented, 1954-1958.

Subject	Number	Percent
Agricultural	208	47
Community	158	35
Homemaking	80	18
Total	446	100

Table 3. Occupation of community residents and community club members for eleven communities and clubs, 1958.

Occupation	Community		Club	
	No.	Pct.	No.	Pct.
Full-time farmer	843	53	136	43
Part-time farmer	191	12	55	18
Public worker	334	21	101	32
Other	218	14	23	7
Total	1586	100	315	100

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[5] The information for this section was obtained from field worker's notes, transcriptions of community club meetings, clubs' secretary record books, and from newspaper clippings from the county paper, **The Daily Corinthian.** Information was available for 427 regular meetings and 202 special meetings held during the years 1954 through 1958.

[6] Frank D. Alexander, **Rural Communities, Organized Groups, and Public Agencies in Alcorn County, Mississippi,** Preliminary Reports in Sociology and Rural Life No. 2; State College, Mississippi Agricultural Experiment Station, 1955.

the heads of households were full-time farmers, 12 percent were part-time farmers, 21 percent were public workers, and 14 percent were in the category 'other'. In contrast, 43 percent of the club member families were full-time farmers, 18 percent were part-time farmers, 32 percent were public workers, and 7 percent were in the category 'other'. In comparison to the total community residents, full-time farmers and the category 'other' were slightly under-represented in the clubs. Part-time farmers and public workers were slightly over-represented in the clubs.

It should be pointed out, however, that the community occupational data was based on a 1955 survey while the club occupational data was based on a 1958 occupational survey. There is evidence to show that between 1955 and 1958 there was a considerable loss of farmers in Alcorn County. In 1955 schedules were taken from a sample of 161 farm operators living in six communities in Alcorn County. Three years later schedules were again taken from the same group of farmers. It was found that over the three-year period 52 (32 percent) of those farming in 1954 were either no longer farming or were farming in different communities. Nine farms were taken over by new operators resulting in a net loss of 43 farm operators in the survey communities.[7]

The occupational structure of the 1958 club member families reflect the loss of farmers in Alcorn County. An occupational survey was made of club member families of seven clubs in 1955 and again in 1958. (Table 4). The results showed a loss in the number of full-time farmers and an increase in the number of part-time farmers and public workers. Full-time farmers decreased from 53 to 39 percent while part-time farmers increased from 16 to 18 percent and public workers from 24 to 36 percent.

Educational programs presented at community club meetings were fairly well balanced, if considered in terms of total agricultural programs presented and number of club member families engaged in agriculture. Forty-seven percent of all educational programs presented at club meetings were on agricultural subjects. (Table 2). Forty-three percent of the families belonging to community clubs were full-time farmers and 18 percent part-time farmers, or a total of 61 percent engaged directly in agriculture. (Table 3). However, the programs were not so well balanced between the interests of men and women. Only 18 percent of all educational programs were on homemaking topics as compared to 47 percent for agriculture. Eighty-two percent of the programs of all types would be of interest to the men. In contrast, the women would be interested primarily in community and homemaking programs, which comprised 53 percent of all educational programs.

Agencies and Organizations Utilized in Presenting Educational Topics

Representatives of agencies and organizations presenting educational programs at regular community club meetings were divided into four major categories. These are (1) county agricultural workers, (2) representatives of public agencies, (3) business representatives, and (4) clubs and other community organizations.

A wide variety of representatives of agencies and organizations were utilized in presenting educational topics at community club meetings. However, 48 percent of all educational programs were presented by county agricultural workers. (Table 5). These workers included the county Agricultural Extension agents, the county Home Dem-

Table 4. Occupation of heads of families belonging to community clubs.*

Occupation	1955		1958	
	No.	Pct.	No.	Pct.
Full-time farmer	116	53	77	39
Part-time farmer	35	16	35	18
Public worker	51	24	71	36
Other	16	7	13	7
Total	218	100	196	100

*Seven clubs in program in both 1955 and 1958.

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[7] Andrew W. Baird and Wilfrid C. Bailey, **Farmers Moving Out of Agriculture,** Mississippi Agricultural Experiment Station Bulletin No. 568; State College, 1958.

onstration agents, representatives of the Agricultural Stabilization and Conservation and Soil Conservation Service representatives, and county Vocational Agricultural teachers.

Representatives of public agencies presented 21 percent of all educational topics. These people included representatives of the County Health Department, Red Cross, area Social Security office, Area Forester, county library, and the Superintendent of Education.

Business representatives presenting educational programs were from dairy processing plants, cotton buyers, county cooperative, poultry and poultry feed dealers, banks, fertilizer dealers, and the telephone company.

Clubs and other community organizations accounted for 15 percent of all educational programs presented. These organizations included adult rural organizations, youth community organizations, sponsoring civic organizations, and Farm Bureau.

Techniques of Presentation

Techniques used in presenting educational programs included movies, slides, lectures, distribution of literature, demonstrations, panel discussions, charts, graphs, models, and plays and skits. Often several techniques were used in presenting one educational topic. Lectures and movies were used more frequently than any other technique. (Table 6).

Special Meetings

In addition to regular meetings, special meetings were held by clubs. Special meetings included (1) workdays, (2) organizational activities, (3) socials, (4) special study meetings, (5) community tours, and (6) community campaigns for such activities as raising club funds, dog vaccination, and rat eradication.

Workdays—A workday consisted of the members of a community club working together on a community project. Workdays accounted for 30 percent of all special meetings during the period 1954-1958. (Table 7).

The members of one club met at the home of a fellow club member for a "face-lifting" of his farm. The "face-lifting" included fencing, terracing, seeding winter cover crops, seeding oats and crimson clover, filling gullies, painting and repairing the barn, applying minerals to the soil, and making minor repairs to the home. The owner paid the cost of materials. Members of the club contributed their labor and equipment, while other supplies and equipment were contributed by agencies and business establishments.

The members of other clubs had major face-liftings of community cemeteries. Clubs located in communities with schools held workdays at the schools for the purpose of repairing the buildings, landscaping the school grounds, and repairing and constructing playground equipment.

Organizational Activities—Each club in the county held special meetings oriented toward organizational activities of the club. This type of special

Table 5. Agencies and organizations presenting educational topics at community club meetings, 1954-1958.

Agencies and organizations	No.	Pct.
County agricultural workers	204	48
Representatives of public agencies	88	21
Business representatives	67	16
Clubs and other community organizations	66	15
Total	425	100

Table 6. Techniques of presentation of educational topics at club meetings, 1954-1958.

Technique	No.	Pct.
Lecture	229	41
Movie	146	26
Distribution of literature	68	12
Demonstration	42	8
Slides	27	5
Charts, Graphs, models	16	3
Panel discussion	15	3
Plays, skits	11	2
Total	554	100

Table 7. Types of special meetings, 1954-1958.

Type of special meeting	No.	Pct.
Organizational activities	61	30
Workdays	60	30
Socials	25	12
Special study	23	11
Fund raising campaign	15	7
Dog vaccination campaign	7	4
Community tours	7	4
Rat eradication campaign	4	2
Total	202	100

meeting also accounted for 30 percent of all special meetings held. (Table 7).

At the beginning of a new club year each club held program planning meetings for the purpose of planning the club goals, projects, and programs for the entire year. Also, three clubs in the county held special meetings for the purpose of reorganizing their clubs. At these meetings problems of the clubs were discussed and recommendations made for the improvement of each club.

Socials—Every year each club invited the members and families of the club's sponsoring civic organization to a social. Food and entertainment were provided by the community club members. In addition, the clubs held numerous other social activities such as harvest suppers, fish frys, and ice cream suppers. Meetings of this type accounted for 12 percent of all special meetings. (Table 7).

Special Study Meetings—Special study meetings, which accounted for 11 percent of all special meetings, were meetings held by clubs for the purpose of studying some special problem or project. In some cases the meetings were county wide, with everyone in the county interested being invited to attend.

For example, leadership training meetings were conducted for all officers and other leaders in all the community development clubs. Meetings were conducted in the county Extension office by Extension specialists for the purpose of discussing the proper methods of carrying out improved farm practices. These meetings were attended by farm committeemen of all the clubs in the county. The committeemen were to carry back to their various clubs the information to be used in carrying out improved farm practices.

Fund Raising Campaigns—Community clubs held special meetings for the purpose of raising funds for the club or some other worthwhile project. Methods used by the clubs to raise funds included basketball games between the men and women of the club, basketball games between members of two different clubs, donkey basketball games, and pie and cakewalks. Clubs also raised funds for such campaigns as the March of Dimes, Community Fund, and the Red Cross. Meetings of this type accounted for 7 percent of all special meetings.

Dog Vaccination Campaigns — Some clubs in the county sponsored community wide dog vaccination campaigns. At a specified time, everyone wishing to have their dogs vaccinated would meet at a central location in the community. Either a vocational agricultural teacher or a veterinarian would administer the vaccine. Meetings of this type accounted for 4 percent of the special meetings.

Community Tours—Community clubs in the county usually held one or two community tours during the year. Attending these tours were community club members and any other interested persons, such as members of the Alcorn County Development Council or members of the club's sponsoring civic organization. Visits were made to the club sponsored fertilizer plots, homes which had been improved, and farms whose operators had entered the various crop raising contests sponsored by the Alcorn County Development Council. These meetings also accounted for 4 percent of all special meetings.

Rat Eradication Campaigns — Each club in the county conducted a rat eradication campaign. The poison was purchased by the clubs. Special meetings were held in the communities and demonstrations were presented showing the correct procedure to place the poison to be most effective. The poison was then placed throughout the community. Meetings of this type accounted for 2 percent of the special meetings.

Goals

One of the primary objectives of community development programs was the improvement of the basic living conditions of the community, including the satisfaction of some of its nonmaterial needs. To accomplish this objective the programs had goals. Goals represent the organizations' desire and were the end results which the clubs were striving to reach.

Alcorn County community development goals may be grouped into four broad types. These are community versus county goals and long range versus short range goals.

County Goals

County goals differed from community goals in scope, the population to which they were directed, and the planners of the goals. The county-wide goals in Alcorn County were in the form of an individual and community score card booklet published by the Alcorn County Development Council. It was used by each community development club in the county. The first score card was used in Alcorn County in 1954. It was drawn up by the county agent of Alcorn County and the agent of an adjoining county. This score card consisted of a set of thirty-three goals in three areas. These three areas were (1) community, (2) social and spiritual, and (3) economic. Community club officers and directors evaluated the accomplishments under area one, while individuals evaluated their own accomplishments under areas two and three.

In March, 1955, a score card committee was appointed by the president of the Alcorn County Development Council for the purpose of setting up a new score card. Members of this committee were divided into three areas, (1) community, (2) home, and (3) farm.

Later the same month this committee met, along with the Extension rural sociologist from Mississippi State University and drew up a new score card. The rural sociologist was present to offer technical advice and assistance. Following are the areas the new county-wide goals were set up in:

I. Community
II. Individual family home life
III. Individual family farm life
    A. Corn
    B. Cotton
    C. Forestry
    D. Hogs
    E. Dairy
    F. Poultry
    G. Soil Conservation
    H. Beef

Each year a score card committee meets and revises the goals as new practices are recommended and emphasis is shifted to other practices. The card has been revised into four areas: community, family, home, and farm.

Community Goals

Whereas county-wide goals found in the score card applied to all community clubs in the county and to all community club members, community goals applied only to individual communities and their members.

Each community development club had at least four committees, (1) program committee, (2) community committee, (3) home committee, and (4) farm committee. At the beginning of each club year the members of these committees met and drew up goals and projects for the year for their club. Usually a representative of the Extension Service met with the committees to assist in the planning. Also, the individual clubs used the county-wide goals found in the score card as a basis for planning their community goals. As a result, all clubs had a few goals that were similar in nature, such as workdays at the community cemetery and school, mailbox improvement, soil testing, year round home gardens, and rat control campaigns. In addition, each club usually had goals that were peculiar to its own community situation. For example, one community was attempting to secure telephone service. The leaders of this movement were also leaders in the community development club. Therefore, the community club had as one of its goals to work toward obtaining phone service for the community. Another club was having to hold its meetings in a community church. One of this club's goals was to work toward building a community center.

Community goals often were more specific and directed toward the individual than were county goals. For example, a county goal read "year-round home gardens—3 to 5 vegetables grown the year-round". A community goal read "five families have year-round home gardens in the community—3 to 5 vegetables each."

Short Range versus Long Range Goals

As has been pointed out previously, goals initiated and carried out during the early stages of a community development program are usually tangible and short range in nature. These are goals that may be completed within a period of one year or less.

An examination showed that the early goals of clubs in Alcorn County were of short range in nature. Following are examples of goals of this type. All could be completed within a period of a few weeks.

1. Have a workday at the community cemetery.
2. Have a workday at each church in the community.
3. Have a community-wide rat control campaign.
4. Repair community road signs and place new ones where needed.
5. Sponsor a workday at the school and add playground equipment.

As the community clubs became more mature and experienced, long range goals were initiated. The tangible, short range goals continued, but increasing importance was given to the long range, more intangible type of goals.

An examination of goals for five clubs in 1954 produced only one goal that could be classed as long range. In 1955 six clubs had a total of six long range goals. In 1957 five clubs had a total of three long range goals, and eleven clubs had a total of nine long range goals in 1958.

It should be pointed out that the Alcorn County Studies were begun in 1955, and at that time an extensive educational program was carried out in the clubs by sociologists from the Tennessee Valley Authority and Mississippi State University, and by the Alcorn County Extension staff. Leadership training meetings were conducted for all clubs by these outside leaders and in some cases helped with goal formation. This probably accounts for the sudden increase in the number of long range goals in 1955. But then, after a decrease in 1957, the number of long range goals increased in 1958 as the clubs became more experienced.

Many of the community goals were economic in nature and directed toward raising family and community income. Following are examples of community goals planned by clubs in Alcorn County for the 1958 club year. These are goals to be accomplished sometime in the future, not something that is done in a matter of days or weeks.

1. Build a community center building for our community.
2. Secure telephone service for the community.
3. Work toward getting the road paved from Smith Bridge road to Mt. Carmel Church.
4. All farmers in the community with adapted land practice timber stand improvement.

Process of Goal Achievement

Goals were achieved in Alcorn County by two major processes. These two processes were contests and a series of projects. The community development program in Alcorn County was contest centered. The Alcorn County Development Council sponsored two types of contests, community and individual.

Community Contests—The community contest was centered around the individual and community score card. The goals in the score card were actually recommended farm and home practices. Community clubs competed with each other for awards in the annual community development contest. The items which were evaluated in the contest were those reflecting the progress of the club organization and community projects. Also considered in the evaluation were those activities of individual club members concerning their home life and farm life. Many club members first learned about recommended practices from the score card and some adopted the practice in order to earn points for their community club. Therefore, the community contest was an important means of goal achievement.

Individual Contests—Individual contests sponsored by the ACDC were in the areas of home improvement, cotton, dairy, swine, forestry, and corn. Each of these areas included recommended farm and home practices. The individual family home life score cards were used as a basis of judging entries in the county individual home life contest. The corn and cotton contest was judged on the basis of the average yield per acre for the two acres entered in the contest. The other contests were judged on the basis of following the score card.

Projects—The other important process of goal achievement in Alcorn County was through a series of projects.[8] A project was a planned undertaking or a piece of work which pointed toward the achievement of a definite goal. Sometimes several projects were completed to achieve one goal. As an example, the following projects were undertaken by one club to work toward the achievement of the goal "all farmers in the community with adapted land practice timber stand improvement."

1. Sponsored one timber stand improvement demonstration in the community.
2. For a program at a regular meeting the Area Forester discussed recommended forestry practices.
3. Encouraged all club members with adapted land to make applications for and set out 1,000 pine seedlings.

IV. INTERACTION PATTERN

A community development club is an example of a group of people doing things together. To fully understand the club structure and functions it is necessary to examine the interaction pattern within the community clubs, between the club and community, and between the clubs and county.

Within the Club

One aspect of interaction within the club is the degree of attendance at regular community club meetings by member families. Club member families attending more than one-third of all regular club meetings were considered to be active participants, those attending from one to thirty-three percent of all meetings were considered to be low or fringe participants, and if no meetings were attended they were considered to be non-participants.

Two-thirds of the club member families of eleven clubs were active participants for the 1958 club year. (Table 8). Forty-two percent attended more than two-thirds of all regularly scheduled meetings. Thirty percent attended one-third or less of all the meetings, while 4 percent did not attend any meetings.

A comparison was made of attendance at regular club meetings with occupations of member families of community clubs for the year 1958. (Table 9). Forty-five percent of member families at regular club meetings were full-time farmers and 19 percent part-time farmers, or a total of 64 percent were engaged directly in agriculture. Thirty-one percent of the average attendance was by public workers and 5 percent were in the category 'other'. Thirty-two percent of the club members were public workers and 7 percent were in the category 'other'.

A second aspect of interaction within the club is participation in the discussion at meetings. Tape recordings

Table 8. Percentage of club member families attending club meetings, 1958.

Percentage of meetings attended	Number attending	Percent attending
68-100	131	42
34-67	77	24
1-33	94	30
0	13	4
Total member families	315	100

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[8] Dorris W. Rivers, **Doing Things the Community Way,** (Mississippi Agricultural Extension Service Publication 367 (5M). State College, Mississippi, 1958.)

Table 9. Occupation of club member families and attendance, 1958.

Occupation	Composition of Club membership		Average composition of club meetings	Average attendance for the year
	Number	Percent	Number	Percent
Farm only	136	43	7	45
Part-time farmer	55	18	3	19
Public worker	101	32	5	31
Other	23	7	1	5
Total	315	100	16	100

were made of ten regular community club meetings in the county during 1955. The recordings were then transcribed and typed. Each speaker was identified by name on the typed transcriptions.

An analysis of the transcribed club meetings showed that relatively few of those in attendance actually entered into the discussion of club activities. Out of a total of 443 people in attendance at the ten meetings, only 115 (26 percent) entered into the discussion. A tabulation of each statement or comment made by people entering into the discussion showed that the club presidents account for approximately one-third, other club officers another one-third, and other club members the final one-third. Three-quarters of those in attendance did not enter into the discussions. (Table 10).

Community club meetings were conducted in a harmonious atmosphere. Approximately 75 percent of those entering into the discussions did so in a constructive manner. Less than one percent of the statements were antagonistic or in disagreement. The remainder of the comments served primarily to clarify the matter under discussion.[9]

Club and Community

What was the interaction pattern between the club and community? What percent of the community families are members of community development clubs? Why are clubs in some communities and not in others? What are the characteristics of those who belong and those who do not?

At the close of 1954 there were six community clubs in Alcorn County with a total enrollment of 195 families. This represented 20 percent of the families in the club communities. Each year thereafter, for the years 1955 through 1958, total family membership increased due to new clubs being organized. However, for the years 1955 and 1956, there was a decrease in the percentage of families in club communities who were members of the clubs. At the end of 1955 there were seven clubs with 218 family members representing 18 percent of the eligible families. At the end of 1956 there were eight clubs with total family members increasing to 228. However, the percentage of families in the club communities who were club members remained the same. In 1957, the percentage of families in the club communities who were club members increased slightly. Three new clubs were organized, bringing the total number of clubs to eleven and total enrolled membership to 309 families representing 20 percent of the eligible families. At the end of the 1958 club year the total enrolled membership was 315 families representing 20 percent of the eligible families. Approximately 45 percent of the rural families in Alcorn County had access to a community de-

Table 10. Participation in discussion at regular club meetings, 1955.

Participation	Number of people	Percent of people	Percent of discussion
Participating in discussion	115	26	—
Club president	—	—	32
Other club officers	—	—	38
All other members	—	—	30
Not participating in discussion	328	74	—
Total	443	100	100

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[9] Andrew W. Baird, **Community Club Programs in Alcorn County, Mississippi, 1952-1955.** (Unpublished Master of Science Thesis, Division of Sociology and Rural Life, Mississippi State University, 1957.)

velopment club in their home community.

As has been pointed out earlier, there appears to be two cycles of growth in the life of community development clubs. This is one possible explanation for the decrease in the number of families in club communities who were members of the clubs for the years 1955 to 1956. The older clubs had passed through the organizational stage and short range goals had been reached. As a result some of the less enterprising eligible community residents lost interest and dropped from the club rolls. When some of the clubs began long range planning in 1957 and 1958 membership began increasing.

Although the community development clubs have been growing in both number and membership, the majority of the rural families in the county did not belong to a club. A comparison of communities with clubs and communities without clubs suggests several important differences existing between the two. Communities with clubs had a higher family income, higher level of participation in non-church organizations, most contact with agricultural agencies, higher socio-economic score, and a higher level of adoption of agricultural practices. (Table 11).

Some individuals were not club members because they did not have the opportunity to join. Others did not take advantage of clubs located right in their home communities. Non-participating families in communities having clubs have been compared to those families belonging to clubs.[10]

Thirty percent of both club and non-club families depended on farming only as their source of income. Forty-two percent of the club member families received both farm and non-farm income. Non-club families had a higher percentage receiving non-farm income and a greater percentage of unemployed. The greatest contrast between the two groups was in tenure. Eighty percent of the member families owned land whereas only 46 percent of the non-members were land owners. Income was higher for club members than non-members. Median gross farm sales was $1917 for club families as compared to $1417 for non-club families, and median non-farm income was $1850 and $1500 respectively. Club member families had adopted 4.1 out of 5 key farm practices as compared to 2.7 for non-member families. The home practices scores were 17.4 compared to 14.9 out of a possible score of 26 on 13 practices.

There is an indication that all community groups were not represented in

Table 11. Comparison of club and non-club communities.

	Club	Non-Club
Source of family income (percent)		
Farm only	27.3	26.9
Farm and non-farm	28.2	16.5
Non-farm only	34.4	38.5
None gainfully employed	10.1	18.1
Occupation of male head (percent)		
Farm only	40.1	36.5
Farm and non-farm	15.4	7.3
Non-farm only	29.1	35.0
None gainfully employed	15.4	21.2
Tenure (percent)		
Owner	48.4	45.5
Owner-renter	13.3	14.0
Renter	31.3	22.3
Sharecropper	5.5	11.6
Laborer	1.6	6.6
Family Income		
Median gross farm income	$1480	$1240
Median non-farm	1770	1460
Agency contact		
Percent of male heads having contact with:		
County agricultural agencies	61.3	53.6
Welfare and health	23.0	30.9
State and regional	15.7	15.5
Percent of male heads having:		
One or more contacts	58.2	52.4
No contacts	41.8	47.6
Participation of male head (percent)		
Active in religious only	14.7	22.4
Active in religious and other	9.5	4.8
Non-members and inactive members	20.8	24.0
Socio-economic score (median)	71.9	69.4
Adoption of agricultural practices score (median)	3.5	2.2
Adoption of home practices score (median)	15.7	15.8
Age of male head of household (median)	48.1	49.2
Years of school of male head of household (median)	8.1	8.1
Take daily newspaper (percent)	49.8	41.9

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[10] Wilfrid C. Bailey, **Designing Education Programs for Specific Audiences,** Preliminary Reports in Community Organization No. 4; State College: Mississippi State University, Division of Sociology and Rural Life, 1957.

community development clubs. The non-club members had a lower level of participation in the community activities. For example, 32 percent of the non-club families could name none of the three top community leaders as compared to only 5 percent of the member families. On the other hand, 50 percent of the club members named two or three of the top three leaders as compared to 33 percent of the non-club members. The non-club families had two years less schooling than the club families. Seventy-six percent of the club families took a daily newspaper as compared to only 37 percent of the non-club families. (Table 12).

There is evidence to show that the community leadership is well represented in the community development clubs. In 1955 a one-third sample of heads of households and homemakers were interviewed in 15 of the 37 communities in the county. Both the heads of households and the homemakers were asked, "Who in this community would be the best people to go to if you needed advice on something to do with farming?" and "Who in this community would be the best people to go to if you wanted to get folks around here together to do something about bettering your community, such as improving the school, churches, roads, etc.?" The homemakers were asked the same question as the heads of households concerning community action. Also, the homemakers were asked, "Who in this community would be the best people to go to if you needed advice on something to do with homemaking?" Community development clubs were located in five of the fifteen communities in which schedules were taken.

Table 12. Comparison of club and non-club families in club communities.

	Club family	Non-club family
Source of family income (percent)		
Farm only	30	30
Farm and non-farm	42	24
Non-farm only	20	34
Unemployed	8	12
Tenure (percent)		
Owner	63	36
Owner-renter	17	10
Renter	21	43
Sharecropper	0	9
Laborer	0	2
Family income (median)		
Gross farm sales	$1917	$1417
Non-farm income	1850	1500
Leadership recognition (percent)		
Name none of top three leaders	5	32
Name 2 or 3 of top three leaders	50	33
Sewell socio-economic score (median)	79.1	68.2
Home practices score (median)	17.4	14.9
Farm practices score (median)	4.1	2.7
Age of head of household (median)	45.4	46.2
Years of school for head of household (median)	9.7	7.7
Take daily newspaper (percent)	76	37

The top three individuals in the five club communities receiving the most mentions for each of the four questions were classified as club officer, club member, or non-club member. As is shown by Table 13, those individuals named as community leaders were actually involved in the community development clubs, with the vast majority having served as a club officer at one time or another. One hundred percent of the top three named as leaders in community action by both the heads of households and the homemakers were members of community development clubs, with 80 percent having served as a club officer. Ninety-three percent of those listed as sources of farming information were members of clubs, with 60 percent having served as a club officer. Those named by the women as sources of homemaking information had the greatest percentage who were not club members, 13 percent. However, 87 percent of this group were club members, with 47 percent having served as club officers. (Table 13).

Club and County

As has been pointed out previously, the rural community development movement in Alcorn County had its beginning under the leadership of a few men in Corinth. As the program grew, with more and more clubs being organized, the rural and urban communities were drawn closer together

Table 13. Percentage of named community leaders involved in community development clubs.

Leadership area	Position in community club		
	Club officer percent	Club member percent	Non-member percent
Farming information	60	33	7
Homemaking information	47	40	13
Community action: (Heads of households)	80	20	0
(Homemakers)	80	20	0

with the organization of the Alcorn County Development Council. Town and country residents were brought closer together through a variety of ways, both formally and informally.

Membership in the development council was about equally divided between the town and country residents. Those serving as officers and committee members were also about equally drawn from town and country members. The council held four regularly scheduled meetings a year. Therefore, both town and country were drawn together to discuss mutual problems and make decisions concerning the community development program.

In addition to the regular council meetings, special committee meetings were held from time to time. For example, the score card committee, composed of both town and country members, met annually to make revisions in the individual and community score card.

Each community club is sponsored by a Corinth Civic Club. Usually representatives of the sponsoring civic club attended the regular community club meetings. Also, each year, each community club usually invited members of the sponsoring civic clubs and their families to one or two socials. In addition to the socials held by the individual clubs an annual awards banquet, attended by both the community club members and sponsoring civic club members, was held in Corinth. An award was made to the civic club doing the best job of sponsoring a community club. Town and country residents got to know and better understand the other.

There has been an attempt to coordinate the activities of the community development clubs and other organizations in the county. For example, in 1958 the County Farm Bureau started meeting jointly with a different club in the county each month. The Farm Bureau was responsible for the program at these meetings. Each organization came to know more about the other. Also the community clubs were being recognized more and more as contact agencies between the town and community. Charity organizations such as the Red Cross contacted the clubs for contributions.

Economic and friendship connections between the county seat and the rural communities were important in the development of clubs. All of the organized communities had close business connections with the county seat. The people went there to trade and to find non-farm employment. In addition, several of the organized communities have close kinship and friendship ties with the county seat. For example, the first club to be organized in the county was done so primarily because of the community's reputation of a strong local leadership and being one of the best farming communities in the county. In contrast, no effort has been made to organize the western hill section of the county. Residents of these communities have a reputation of going into the adjacent county for the majority of their goods and services. These communities have limited agency contacts with the county seat and have not expressed interest in the community development program.

V. FUNCTIONS OF COMMUNITY DEVELOPMENT CLUBS

The functions performed by community development clubs may be divided into two categories, formal functions and informal functions. The formal functions of the clubs were the specifically stated and recognized purposes of the clubs. These functions were either written in the by-laws of the organization or verbally stated by club members or people working with the clubs. The informal functions were those that were not officially recognized as purposes of the clubs but, never the less, occurred as a result of the operation of the clubs. These categories are not necessarily distinct and mutually exclusive. There is considerable overlapping.

Formal Functions

Community development—The major function of the community development clubs in Alcorn County was the improvement of conditions in the county, or community development. The Alcorn County Development Council By-Laws explicitly stated that the council was formed for the purpose of promoting the economic, spiritual and social life of every farm family in Alcorn County, and to bring about a closer relationship between the citizens living in the country and those living in the city of Corinth.

One measure of the degree to which this general objective was achieved can be obtained by examination of the scores made in the annual community club contest. (Table 14). The score card contained four sections. The individual families were scored in three areas, home, family, and farm. The group activities of the club contributed to the community score. The average family score and the community score gave the total club score. A comparison of the combined scores of the seven clubs active in the period of 1955 through 1958 shows that there was considerable improvement. Actually the improvement was greater than the points indicate because the regulations and requirements for making points were tightened during the period. The index rose 14 points or nearly one-third. The community score was the only area that showed an actual improvement in 1958 over 1957. This reflects a trend in the club program from an emphasis on education to a greater concern for general community improvement or community development.

Table 14. Club contest scores, 1955, 1957, and 1958.*

	1955	1957	1958
Home score	46	59	56
Family score	**	69	62
Farm score	27	59	51
Community score	53	60	62
Total	46	61	60

*Average for seven clubs entering contest in all of these years. Score is percentage of total possible points.

**Family score not included in 1955 contest.

Improved relations between town and country—This was the second objective stated in the by-laws. It has been achieved through several means. The membership of the Alcorn County Development Council included people from town and each club had a Corinth civic club as a sponsor. Besides these official ties some of the informal functions discussed later in this section involved development of closer relations between the rural communities and the county seat town. Most club members and people in Corinth who are familiar with the clubs stated that this had been one of the more important effects.

An educational media—One aspect of community development through the community clubs was found in the educational programs. A general idea of the role clubs played in education of the members can be gained from improvement made on the score cards submitted by individual families in the annual contest. (Table 14). The farm life score showed the greatest improvements and reflected the agricultural emphasis of the educational programs presented at the clubs.

Special emphasis was placed on the use of clubs to promote the adoption of new and approved farm practices. The final goal of an educational program is not just the spread of information, but utilization of the new knowledge. In order to measure the effect of the educational program in influencing the adoption of agricultural practices, a group of 161 farmers were interviewed in 1955 concerning their use of 12 practices during the 1954 crop year, the year before special educational programs began. It was found that there was a wide gap between knowing about a practice, thinking it was best, and using it.[11] In 1958 the same group of farmers were interviewed concerning their 1957 crop year.

Comparison of the adoption of recommended farm practices by residents of club and non-club communities for the years 1954 and 1957 points to the effectiveness of the club educational programs. (Table 15). The farmers in the non-club communities showed an increase of 26 percent, whereas, the club communities improved only 15 percent. Comparison of the club members and the non-club members in the club communities shows the same relationship. At first glance this would seem to be the reverse of what would be expected. Re-examination shows that the non-club members in club communities and the non-club communities had an average score in 1957 that was still below that of the club members in 1954.

In 1957 a number of practices were used by all or nearly all the club members for whom these practices were applicable. Thus the non-club members had more room for improvement. Considering practices not used in 1954 as the possibility for improvement, members of community club added 68 percent of the total possible compared with 37 percent for the non-club members in club communities and 40 percent for the farmers in non-club communities. (Table 16). In other words the club member improvement was 84 percent greater than non-club members in the club communities and 70 percent greater than non-club communities.

Club members made 100 percent improvement in four practices: planting certified cotton seed, poisoning cotton four or more times, use of warfarin type rat poison, and buying fertilizer by plant food content. That is, all club members who did not use these practices in 1954 did so in 1957. These four practices were subjects of special educational programs carried out through the clubs. In order to counteract the reduction of cotton acreage, the county agent stressed adoption of practices that would increase yield on the remaining acreage. The community clubs took it upon themselves to see that warfarin type rat poisons were used. Each year the clubs purchased enough rat poison for all the members to use and in some instances the clubs held a field day in which club members supervised the placing of the poison on the farms in the community. The

Table 15. Change in the use of recommended farm practices, 1954-1957.*

	Used 1954 (Pct.)	Used 1957 (Pct.)	Change 1954-57 (Pct.)
Club communities:			
Club members	76	85	12
Non-members	49	59	20
Total community	60	69	15
Non-Club communities	47	59	26
Total	59	68	15

*Average of 12 practices.

Table 16. Adding and dropping of farm practices: Club and non-club members, 1954-1957.*

	Practices added (percent of possible improvement)	Practices dropped (percent of possible loss)
Club members	68	9
Non-club members in club communities	37	20
Non-club communities	40	16

*Average of 12 practices.

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[11] The practices included in the survey were: sidedress corn with nitrogen, thick space corn on better land, plant hybrid seed corn, plant certified cotton seed, poison cotton four or more times a year, cull timber, soil test every five years, mow pastures or poison weeds, keep written records, use most fertilizer on better soil, use warfarin type rat poison, and buy fertilizer by plant food content. Herbert A. Aurbach and Harold F. Kaufman, "Knowledge and Use of Recommended Farm Practices." **Farm Research**, Vol. 19, No. 6, (June) 1956.

assistant county agent with the help of the local farmers' coop manager, and a TVA sociologist planned a 4-H Club demonstration on buying fertilizer by plant food content. This prize winning demonstration won state honors. The boys presented their demonstration before all of the community clubs and other farm groups in the county.

Comparison of the use of farm practices in both 1954 and 1957 showed that the improvements made were actually the net results of both adding and dropping of practices. The farmers surveyed picked up 18 percent and dropped 9 percent for a net gain of 9 percent. In other words the total gain was the result of picking up two practices and dropping one for a net of one gained. Thus the desired end of the education program is not just getting farmers to try a practice but securing continued use. The club members and non-club members were compared on dropping of practices. The measure used was the percentage of the practices used in 1954 not used in 1957. Club members dropped only 9 percent of the possible number, non-club members in the club communities dropped 20 percent, and residents of non-club communities dropped 16 percent. An extreme example of instability in the use of a practice was keeping records by the non-club members in the club communities. In both 1954 and 1957 the same number kept records. However, all of those who kept records in 1954 did not keep them the second survey year and none of those who kept records in 1957 had done so during the first survey period. In other words, there was complete turnover. In the case of the club members in the same communities the 60 percent gain in this practice was associated with a drop of only 11 percent. Thus, it would seem that not only did club members try more of the new practices but, in addition, they were more likely to continue their use.

Community cohesion—Another recognized function of the community clubs was the development of community cohesion. The clubs were thought to be a force to bind the community together. In 1955, respondents in six community clubs were asked to give the purpose of their organization. Answers included such statements as: "For the betterment of the community and to get people to pull together"; "To bring the community together and overcome the split"; and "To bring the people closer together and make better neighbors and a better place to live."

In 1958 the membership of six clubs was asked for reasons for attending club meetings. A total of 62 percent of the respondents said that they attended the regular club meetings either because they felt it their duty as a citizen of the community or because they enjoyed the fellowship of their neighbors.

Informal Functions

Change agent—The overall view of the clubs in community development and associated educational programs emphasized the value of change. The clubs interested people in doing something to solve their problems, or in other words, change. Stimulation of concern for change has been found to be an important factor in community development.

Although there is evidence that the educational programs were effective in securing the adoption of new farm and home practices, there is the possibility that the clubs attracted as members people interested in change. The occupational distribution of the clubs showed an under representation of full-time farmers and an over representation of full-time non-farm workers. The county sample found that 32 percent had only non-farm employment and that 15 percent had never farmed. This would indicate that half of those employed off of the farm had changed their occupation. Thus, if the clubs attracted people interested in change it would be expected that non-farm workers would be over represented.

Another role of the club as a change agent would be to resist change. There were frequent references to the community clubs as a means to prevent the disappearance of the rural community on the face of declining population and growing cities. Thus, the club becomes an agent to foster desirable change and to resist undesirable change. It is possible that in some cases community development clubs could be a conservative movement to preserve the old community and its culture. In this respect, community development clubs could exhibit some of the characteristics of what anthropologists have called "nativistic movements." No club in Alcorn County appeared to be of the conservative type. However, although most members seemed to emphasize the change, some were more concerned with resisting change.

Action facilitation—The clubs were the basis of community action in meeting a number of problems. Community clubs in Alcorn County have been successful in providing the group action and pressure needed for road improvement, extension of telephone lines, renovation of the county courthouse, and similar improvements of services for the communities. The clubs represented the communities as the local action group.

Community identity—The open country rural communities were more or less informal entities. Although recognized and identified by name, they lacked a corporate body or an over-all governing agency. The community clubs sometimes assumed this function. Because of this, communities with development clubs were sometimes called "organized communities".

Groups from outside the community approached the community through the clubs. Various county agencies attempting to organize a watershed program began their work in the local communities through the clubs. The Alcorn County Blood Bank organized group coverage based on the club members. Fund raising groups carried out their rural campaigns through the clubs. An officer in one fund raising organization reported that by working through the clubs, each club now donated more than was formerly received from the whole rural area.

Assumption of functions—The community development clubs have assumed some functions formerly performed by other groups. The Parent-Teachers Association was, at the time of the study, weak in the rural schools. The community clubs had, as one of their community life goals, encouragement of school attendance. They also held workdays at the schools for painting, landscaping, and building of playground equipment. Thus, these clubs were doing things usually associated with the PTA. Many of the communities had a local cemetery in connection with one of the churches or controlled by community cemetery association. Each of the clubs held workdays at the cemeteries for cleaning and general improvement of the grounds. In one community the cemetery association was formally incorporated into the club program.

An intermediate or catalytic agent—The community clubs provided a base for various educational programs. For example, the manager of the Alcorn County Cooperative made important use of the clubs in his fertilizer education programs. He was one of those responsible for the organization of the first club. Outside of the county Extension staff he was one of the more active townspeople in the club movement. At meetings he gave announcements about fertilizers and he helped with the prize winning 4-H Club fertilizer demonstration.

In a similar manner the programs of the Extension Service, Soil Conservation Service, Agricultural Conservation and Stabilization, and other agencies were presented through the clubs. Besides the formal educational programs in the club meetings, public attention was called to their programs through annoucements in club meetings, newspaper articles about the club meetings, tours, demonstrations, and recruitment for special enterprise meetings.

In the second adoption survey farmers were asked about their sources of agricultural information. Only two people named the club. However, they did mention the activities of the various agricultural agencies. Thus, when the county agent presented an educational program on cotton insecticides, the county agent, not the club was considered to be the source of information. The clubs served to increase the contacts with agricultural leaders. This became increasingly important when it was realized that because of the number of non-farmers in the clubs, the educational programs had to include non-agricultural subjects.

Thus, the clubs seemed to serve as an intermediate or a catalytic agent through a process of bringing educational agencies and the people closer together. The detailed educational programs were carried on outside the club meetings. Further, agency personnel reported that they used the clubs as a springboard from which to launch their educational programs for the entire county.

Community survival—Much concern has been expressed because rural communities have been losing their identity and have been dying out. Comparison of the communities that have remained relatively strong with those that were dying out showed that the strong community carried out certain social and economic functions for its inhabitants. There was a balance between dependence on local and outside leadership.[12] With the general loss of services and organizations in the rural area, the community development club was the type of organization that could help the community meet the requirements of survival.

Leadership training—There was only a weak tradition of local action through organized activity. At the beginning of the community development program the lack of local rural leadership was a crucial problem. It was necessary to have leadership development meetings. Both town and country residents have said that one of the greatest benefits of the community clubs has been the training of leadership, not just for the clubs but for other activities.

Compulsion for conformity—One of the basic assumptions of people working with community clubs was that one of the strong forces in the educational program was the compulsion to conform. The club set the pattern and social pressures caused the members to conform. Similarly it has been assumed that even if all the families did not belong to the club, community-wide pressures and observation of the benefits from new ways of doing things would cause the spread of the club influence.

No measurement of this compulsion for conformity was made. Observation of club meetings revealed that laggards were urged to follow score card recommendations so that they would not let the club down in the county contest. The adoption score made by non-club members in club communities were more like those of residents of non-club communities than the club members. Thus, there is some question as to the influence of conformity having an effect outside of the clubs.

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[12] Lucy W. Cole, **What is Happening to Rural Neighborhoods?** Mississippi Agricultural Experiment Station Information Sheet 598; State College, 1958; Lucy W. Cole, "Selected Factors Associated with the Organization of Community Development Clubs". (Unpublished Master of Arts Thesis, Department of Sociology and Rural Life, Mississippi State University, 1959).

BULLETIN 598 MAY 1960

The Study Of
Irrigating Cotton
In Hill Sections Of Mississippi

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THE STUDY OF IRRIGATING COTTON IN THE HILL SECTIONS OF MISSISSIPPI

By E. A. KIMBROUGH, JR. and E. F. RATLIFF[1]

This bulletin is a progress report on cotton irrigation studies conducted by the Mississippi Agricultural Experiment Station. Results reported are those during the dry, moderate, and wet years of the 1950's. They indicate some of the hazards, potentials, and excellent results of irrigation.

Weather records at Mississippi State University indicate a non-uniform pattern of rainfall during the growing season. Some years rainfall has been excessive, causing serious crop damage. At other times droughts have ruined crops. Only 31.32 inches of rainfall occurred during 1952. During 1958, the total rainfall was 52.68 inches with 25.96 inches occurring during the most important growing season. The lack of a uniform rainfall pattern makes it hard to predict the economical use of irrigation. Table 1 shows the variation in rainfall during the experiments reported here.

In the hill area, excessive runoff occurs when rainfall is of a high intensity. Therefore, moisture stored in the soil for crop use is not necessarily the gross amount of rainfall, but decreases by the amount of runoff. Some factors affecting the amount of runoff are: Condition of the soil at the time of the rain, length of time the high intensity rainfall continued, stage of growth of the crop being produced, and natural infiltration of the soil.

Irrigation Studies at State College

Cotton has been generally classed as a dry weather plant. Several factors lead to this impression, During wet seasons, insects are hard to control, plants make vegetative instead of productive growth, and lint is damaged by boll rot, especially if plants grow excessively. During dry years, better percentage of lint turnout is obtained and the lint is of higher quality,

Although cotton is classed as a dry weather plant, farmers know from experience that deficient moisture during the growing season will result in decreased yields. To be assured of a cotton crop during dry seasons, many farmers are turning to irrigation, thus stabilizing their production.

Tests are being conducted[2] on cotton in the hill sections to determine the effects of irrigation: On various varieties, with various levels of nitrogen, with deep tillage, by mechanical impoundment of water in the furrows to prevent runoff, and on mechanization practices.

To determine when to irrigate, tensiometers are used to measure water tension in the soil. The irrigation schedule is based on 800 cm of water tension at a depth in which a major part of the roots are located.

Variety and Irrigation: This test was begun at State College in 1952[3] and was continued through 1959. The purpose was to determine if any varieties are particularly responsive to irrigation. The test was planted on Houlka fine sandy loam from 1952 through 1957, and on Kaufman fine sandy loam from 1957 through 1959.

Shallow Kaufman fine-sandy loam produced a significant increase from irrigation in 1957 while the deep Houlka fine sandy loam produced no significant increases. Yields have been very good in the deeper soil, but little response to irrigation was received, except during the extremely dry years. Yields were not as high in the shallow soil, but a greater response to irrigation was received due to the lower water holding capacity. This indicates the importance of soil types in measuring response to irrigation.

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[1] Assistant Agricultural Engineer, Mississippi Agricultural Experiment Station.

[2] Jointly with Agronomy Department staff.

[3] "Twelve Varieties of Cotton Used in Irrigation Test," R. L. Dickinson and J. F. O'Kelly, Mississippi Farm Research, January, 1953.

Yields are shown for the varieties in Table 2.

Yields are not given for the years in which no significant increases were obtained for irrigation. The yield differences do not show a significant variety-irrigation interaction.

Fertilization and Irrigation: Large increases in yield with irrigation probably

Table 1. Rainfall during growing season and total rainfall for each year, 1950-1959

Inches

Year	April	May	June	July	August	September	Total of year
1950	1.95	4.50	2.41	8.51	9.53	6.86	67.37
1951	4.08	4.47	5.98	3.15	3.25	3.40	63.43
1952	2.27	3.20	.29	2.06	2.74	1.21	31.32
1953	6.57	6.29	2.59	5.26	1.82	.72	48.58
1954	3.40	3.71	.81	3.75	1.87	1.23	40.08
1955	5.56	4.25	2.35	7.42	1.35	.82	41.76
1956	6.19	3.94	2.45	2.41	2.37	.63	51.35
1957	3.60	2.36	8.56	1.40	.08	6.50	51.97
1958	7.05	4.70	7.15	6.98	2.68	4.47	52.68
1959	5.89	8.01	2.06	1.20	2.25	4.53	46.22

Table 2. Variety tests with irrigation.

	1952		1954		1957		1959	
Varieties	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
			Lbs. of lint per acre					
Plains	997	720	892	699	651	506	837	702
Coker Wilt	923	633	931	642	570	471		
Bob Shaw 1-A	915	645	754	582				
Delfos 9169	914	792	856	682	510	423	886	671
Delfos 7343	893	720	867	662				
Stoneville 2-B	891	705	790	674				
Empire	886	641	758	638	610	549	874	678
Fox	874	636	790	615	557	473		
Hi Bred	863	669	920	672	620	494		
Deltapine 15	860	669	798	663				
Arkot 2-1	842	687						
Wilds	665	533	653	552				
Acala 4-42			990	730	490	466		
Des 1000					674	528		
Dixie King					640	495	895	713
Deltapine SL					619	486	789	616
Auburn 56					626	518	938	759
Stoneville 7					561	522	936	728
Pope							664	550
Coker 100A, WR							967	791
Rex							862	703
Fox 4							801	648
Des 1007							779	707
Average	875	671	833	651	594	494	852	689
No. of irrigations	5		4		2		2	
Amt. of water (in.)	6.0		8.3		5.0		4.0	
Soil type	Houlka fine sandy loam		Houlka fine sandy loam		Kaufman fine sandy loam		Kaufman fine sandy loam	

require an increase in the rate of nitrogen. The purpose of this test is to determine the nitrogen rate that would give the best yield increase with irrigation. It was initiated in 1953 and is still being conducted.

Rates of nitrogen used were 30, 60, 90, and 120 pounds per acre with 60 pounds of P_2O_5 and 60 pounds of K_2O for the years 1953 through 1957. During 1958, the tests were revised to 60, 90, 120, and 150 pounds of nitrogen per acre with split application for the higher rates rather than applying all the fertilizer prior to planting. Both sprinkler and furrow irrigation were used to distribute the water on the plots.

There were increases due to irrigation in 1953 and 1954, which were dry years. The effects of fertilization and irrigation for these two years are shown in Table 3. In the moderate and wet years that followed, the small increases in yield were not significant.

Deep Tillage: This test was designed to determine the effect of deep tillage (cultivation) on cotton production and irrigation requirements.

Treatments with and without irrigation carried out in 1957 and 1959 were: (1) Conventional cultivation; (2) deep cultivation; (3) conventional cultivation with front sweeps next to row and deep chiseling in the furrow. (4) Deep cultivation with front sweeps next to row and deep chiseling in the furrow. Rain prevented the test from being accomplished in 1958. The use of sub-surface sweeps in the furrows was tried but discontinued due to excessive disturbance to the plant. More water could be applied to the chiseled land before runoff occurred.

Tall irrigated cotton may cause an insect control problem.

Results are shown in Table 4.

It appears that deep tillage with irrigation may affect production adversely if wet periods occur during the growing season, as in 1957 and 1959.

More information is needed and the test will be continued but moved to a soil with less water holding capacity.

Mechanical Impoundment: The purpose of this test is to determine the feasibility of using check dams in middles to

Table 3. Fertilization test with irrigation.

	30 lbs. N per acre		60 lbs. N per acre		90 lbs N per acre		120 lbs N per acre	
	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated	Irrigated	Not Irrigated
	Lbs. of lint per acre							
1953	1167	1155	1203	1007	1083	983	1178	813
1954	1030	784	1100	731	1019	830	998	882

Table 4. Tillage and irrigation test.

Treatment	1957 Irrigated	1957 Not Irrigated	1959 Irrigated	1959 Not Irrigated
	Lbs. of lint per acre			
Conventional cultivation	688	749	678	489
Deep cultivation	639	660	636	628
Conventional cultivation and chiseling	742	696	553	595
Deep cultivation and chiseling	702	740	480	641

Table 5. Cotton yields using check dams.

Treatment	Satisfactory rate of application	Irrigated	Not Irrigated	Irrigated	Not Irrigated
		Yields in lbs. lint per acre			
Check dam	1.40 in./hr.	567	371	664	598
Conventional	.38 in./hr.	604	420	696	552

increase the application rate of water by sprinklers. Treatments were as follows: (1) Irrigated, conventional furrow; (2) irrigated, check dam furrow; (3) Non-irrigated, conventional furrow; and (4) Non-irrigated, check dam furrow.

The test was conducted in 1957 and 1959 on Ora fine sandy loam with a very impervious subsoil. The sandy topsoil gave a fairly high intake rate early in the irrigation period, but tended to seal off quickly which lowered the infiltration rate.

Due to the check dams, 2.2 inches could be applied at the rate of 1.4 inches per hour before runoff occurred. Only 0.7 inches could be applied at .72 inches per hour in the irrigated conventional furrow area before runoff occurred. Runoff rate from the conventional furrow was measured and subtracted from the application rate, giving the infiltration rate of .38 inches per hour.

This shows that check dams allow a more rapid rate of application without high rate of runoff.

Irrigation and Mechanization Practices: When ground-operated rigs are used for insect control on irrigated fields, the insect control program often must be changed in order for it to fit the irrigation program. This is due to the inability of the poison machine to operate in wet fields and to the poison being washed off by irrigation. One program must wait on the other. The operator can decide whether to spray with a quick kill poison prior to irrigation, or irrigate and then apply the insecticides as soon as a machine can maneuver in the field.

Late cultivation, as well as insect control, with conventional equipment is often prevented in irrigated fields by dense vegetative growth, especially in fields of high nitrogen rates. Irrigated cotton obtained a height of 6.4 feet in 1955. In 1959, test plots became grassy after the second irrigation. Boll laden limbs interlocked in the middles preventing a late cultivation.

Hill farmers who irrigate their cotton may need to invest in well shielded machines for late weed and insect control.

CONCLUSIONS

Cotton will respond to irrigation provided the drought period exceeds the carrying capacity of the soil. This is not a definite length of time for all soils. Soils of low water-holding capacity require more frequent applications of water. When these frequent applications are not available by rain, irrigation will increase production.

High fertilization rates, especially nitrogen, have caused some excessive vegetative growth and created a problem in applying insecticides in irrigated areas.

Soil condition at the time of irrigation has influenced the infiltration rate of the water. Cultivation prior to irrigation increases infiltration.

Check dams in the furrows allow a higher application rate.

The lack of a more uniform rainfall pattern makes it difficult to predict the economical use of irrigation.

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Mississippi's
OLDER PEOPLE

By Marion T. Loftin

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AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

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MISSISSIPPI'S OLDER PEOPLE

By MARION T. LOFTIN

The past few years have witnessed an ever-growing awareness of the increasing importance of older people in our population. From being a small group in both absolute and relative numbers only a few decades ago, persons 65 years old and over numbered 12,269,637 in 1950 and made up 8.1 percent of the nation's population. Students of demography are convinced that, barring the development of unforeseen circumstances, both the numerical and proportional increases of older people in the population will continue for several decades to come.

Mississippi's position in the South and the nation with respect to the proportion of its population 65 years old and over in 1950 is shown in Table I. On examining the data in this table, one fact stands out immediately. That fact is the rapid rate at which the proportion of older people in Mississippi's population increased from 1930 to 1950. During this period, persons 65 years old and over nearly doubled in proportion from 3.6 percent to 7.0 percent. This rate of increase for Mississippi was considerably higher than the rate for the nation and was exceeded in the South only by Oklahoma, whose similar increase was from 4.1 percent to 8.7 percent. Although in 1950 a smaller percentage of Mississippi's population than of the population of the nation was in the 65 years old

SUMMARY

In 1950, one out of every 13 Mississippians, or 152,964 persons in all, had reached the age of 65 or over. Aged persons in the population of the state have been increasing at a rapid rate. The greatest increases between 1940 and 1950 were registered by the rural nonfarm and the urban population groups in that order, except that persons 85 and over preferred urban residence in greater proportion than rural nonfarm. Older females are increasing in number more rapidly than older males. As a result of a heavy out-migration of the young rural farm population, farm operators are becoming more and more concentrated in the upper age brackets. Because of this same out-migration, the proportion of the aged in rural farm areas has increased in spite of either decreases or very small increases in actual numbers.

In 81 of Mississippi's 82 counties, the nonfarm segment of the population registered a greater relative increase in the number of aged persons than the farm segment. The greatest increases generally occurred in counties with a relatively large farm population, providing a larger number of candidates for migration to nonfarm areas. By and large Mississippi's elderly citizens increased slowest in the north central portion of the state. They showed the greatest increase in the southern and Delta areas.

In relation to size of community, the greatest increases in the number of people 65 years old and over occurred in places of more than 10,000 inhabitants and fewer than 1,000. Of cities with 10,000 or more inhabitants in 1940, the three with the greatest increase in the aged population were located in the Delta.

Largely as a result of historical factors which affected the birth rate, the 85 and over age group increased but little from 1940 to 1950 in relation to the 75-84 and the 70-74 age groups. Persons 65-69 years old also increased slowly during the decade preceding 1950.

and over category, the gap between the state and the nation was narrowing steadily. In 1930 the percentage difference in the proportion of the aged between Mississippi and the nation was 1.8, in 1940 it was 1.5, and in 1950 it was 1.1. In 1950 only 4 of the other 12 Southern states had in their populations substantially higher proportions of the aged than did Mississippi. These states were Arkansas, Florida, Kentucky and Oklahoma.

Table I. Percent of the Population 65 Years Old and Over for the Southern States and the U. S. 1930, 1940 and 1950

State	1930	1940	1950
United States	5.4	6.8	8.1
Mississippi	3.6	5.3	7.0
Alabama	3.8	3.8	6.5
Arkansas	4.1	5.5	7.8
Florida	4.9	6.9	8.6
Georgia	4.1	5.1	6.4
Kentucky	5.5	6.6	8.0
Louisiana	3.6	5.0	6.6
North Carolina	3.8	4.5	5.5
Oklahoma	4.1	6.1	8.7
South Carolina	3.4	4.2	5.4
Tennessee	4.7	5.9	7.1
Texas	4.1	5.4	6.7
Virginia	4.8	5.8	6.5

Source: Halbert L. Dunn, **Health and Demography**, U. S. Department of Health, Education, and Welfare, National Office of Vital Statistics, Oct., 1956, p. 53.

Race, Residence and Sex

The data in Table II give some knowledge of the magnitude of the aged population and of the changes in it with regard to race, residence and sex.[1] The total number of persons 65 years old and older in Mississippi in 1940 was 115,418, while in 1950 it was 152,984. Substantial increases in the number of persons in this age group occurred in the white and nonwhite populations, both male and female, in the state as a whole. However, when the data are further classified by residence, it is readily apparent that the bulk of the increase in the numbers of the aged occurred among urban and rural nonfarm people, and that rural farm areas either experienced no increase, or actually, a decrease.

Measures of change which permit easier comparisons of changes in the aged population between the various racial and residential groups and between the sexes are found in Table III. These figures show the tremendous speed at which the aged population of Mississippi had been increasing. Persons 65 years old and over in the state's population increased by 37,546 persons from 1940 to 1950, which represented a percentage increase of 32.5 The magnitude of this increase is underscored when one remembers that during the same period the state lost population. Furthermore, in all racial and residential categories, without exception, aged females gained in numbers more rapidly than aged males and in all sex and residential categories the aged whites increased

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[1] The new urban defiinition for 1950 has been used throughout this paper. This has been done because: some data are available in greater detail under the new definition; in order to provide comparability in some instances with 1960 data when they become available; and as a convenience factor. Rather extensive tabulations show that, in Mississippi, this practice does not result in a significant alteraton of the results of tabulations or analysis. Less than 1 percent (0.9) of the total urban population, and but 1.1 percent of the rural nonfarm inhabitants is affected by the new urban definition. The numbers of the aged classified as urban and rural nonfarm are changed even less by the use of the new urban definition for 1950 instead of the old, the percentages being 0.7 and 0.3, respectively.

Table II. Number of Persons 65 Years Old and Over by Race, Residence and Sex, Mississippi, 1940 and 1950.

Residence and Race	Males		Females		Total	
	1940	1950	1940	1950	1940	1950
Total Population:						
White	30,818	41,797	30,369	45,118	61,187	86,915
Nonwhite	28,311	33,087	25,920	32,962	54,231	66,049
Total	59,129	74,884	56,289	78,080	115,418	152,964
Rural Farm:						
White	18,330	19,851	15,274	17,417	33,604	37,268
Nonwhite	20,437	19,476	16,263	16,022	36,700	35,498
Total	38,767	39,327	31,537	33,439	70,304	72,766
Rural Nonfarm:						
White	6,268	11,333	6,867	12,975	13,135	24,308
Nonwhite	3,789	6,803	4,367	8,076	8,156	14,879
Total	10,057	18,136	11,234	21,051	21,291	39,187
Urban:						
White	6,220	10,613	8,228	14,726	14,448	25,339
Nonwhite	4,085	6,808	5,290	8,864	9,375	15,672
Total	10,305	17,421	13,518	23,590	23,823	41,011

Source: U. S. Bureau of the Census, **U. S. Census of Population, 1950**, Vol. II, Part 24.

at a faster pace than the aged Negroes. Aged whites increased by 42.0 percent from 1940 to 1950, an increase that was twice as great as the increase for aged Negroes who increased only 21.2 percent. Similarly, elderly males increased by 26.6 percent while elderly females increased by 38.7 percent. These trends are, in part, a reflection of mortality differentials favoring the white and the female portions of the population and may be expected to continue.

Of considerable interest and significance is the differential growth of the aged population classified as rural farm and rural nonfarm. The white farm population of the state aged 65 and over increased by only 10.9 percent from 1940 to 1950. The corresponding nonwhite group in farm areas actually decreased by 3.3 percent during the decade in question. However, persons in the age group 65 and over residing in rural nonfarm areas nearly doubled their numbers from 1940 to 1950, there being an increase of 85.1 percent among whites and of 82.4 percent among nonwhites. Corresponding figures for urban places in the state are almost as impressive, being 75.4 percent and 67.2 percent, respectively. The total increase in the aged of all races and both sexes during the period in question was 3.5 percent in the rural

Table III. Number and Percent Change in the Population 65 Years Old and Over by Race, Residence and Sex, Mississippi, 1940-1950.

Residence and Race	Male		Female		Total	
	Number	Percent	Number	Percent	Number	Percent
Total Population:						
White	10,979	35.6	14,749	48.6	25,728	42.0
Nonwhite	4,776	16.9	7,042	27.2	11,818	21.2
Total	15,755	26.6	21,791	38.7	37,546	32.5
Rural Farm:						
White	1,521	8.3	2,143	14.0	3,664	10.9
Nonwhite	-961	-4.7	-241	-1.5	-1,202	-3.3
Total	560	1.4	1,902	6.0	2,462	3.5
Rural Nonfarm:						
White	5,065	80.8	6,108	88.9	11,173	85.1
Nonwhite	3,014	79.5	3,709	84.9	6,723	82.4
Total	8,079	80.3	9,817	87.4	17,896	84.1
Urban:						
White	4,393	70.6	6,498	79.0	10,891	75.4
Nonwhite	2,723	66.7	3,574	67.6	6,297	67.2
Total	7,116	69.1	10,072	74.5	17,188	72.1

Source: U. S. Bureau of the Census, **U. S. Census of Population, 1950**, Vol. II, Part 24.

farm population, but 84.1 percent in the rural nonfarm and 72.1 percent in the urban population. Of the total gain of 37,546 in the number of aged persons from 1940 to 1950, 35,084 or 93.4 percent were added in the nonfarm areas.

There is no reason to believe that mortality among the aged in the rural population is sufficiently at variance with that of the aged in the rural nonfarm and urban populations to cause these highly divergent rates of growth. It is also self-evident that births do not contribute to the number in the 65 and over age group except on a long-term basis, greater than the 10 years covering the decade between 1940 and 1950. Therefore, of the three causes of population change only one, migration, remains as an explanation of this phenomenon. The character of this migration in turn is largely intrastate since relatively few of the aged have migrated from other states to Mississippi or from Mississippi to other states. With these facts in mind it becomes clear upon consideration of the data in Table III that the intrastate migration of the aged in Mississippi has been from rural farm areas to urban and rural nonfarm ones and particularly the latter. Urban residence includes all persons living in towns and cities of 2,500 or more inhabitants, while rural nonfarm residence takes in persons living "outside of urban areas who do not live on farms." Consequently, it is evident that as members of the farm population reach age 65, they leave their farms for cities and for towns of less than 2,500 inhabitants in great numbers, although it is possible that some elderly persons who formerly lived on farms and were, therefore, classified as being in the farm population now no longer are so classified even though they have not changed their actual place of residence, because the land is no longer employed for farm uses or has been incorporated into another farm.

The Role of Migration

When the data contained in Table III are considered in relation to the data in Table IV which show the percent of the aged population by race, residence and sex for 1940 and 1950, considerable light is thrown on migratory currents of the younger population. This comparison shows that although the aged, nonwhite rural farm population decreased in number during the decade preceding 1950, the proportion of that population which was 65 years old and over increased from 4.7 percent in 1940 to 6.0 percent in 1950. Such an occurrence could only have resulted from an exodus from rural farm areas of the younger nonwhite inhabitants. The same is true to a lesser extent of the aged white rural farm population.

In Mississippi, as elsewhere in the nation, elderly males tend to remain on the farm to a greater extent than elderly females who more readily migrate to villages and cities. While there are considerably more females than males among the aged population of the state as a whole, the reverse was true for both the white and nonwhite rural population in 1940 and 1950, (see Table II). In keeping with previous observations concerning the rapid rate at which the elderly increased in urban and rural nonfarm areas, the greatest concentrations of the aged were to be found in those areas in 1950. This is particularly true of the rural nonfarm population which while gaining aged migrants, has been losing younger ones. The greatest concentration of the aged was present among nonwhite rural nonfarm females, 9.5 percent of whose numbers belonged to the 65 and over age group in 1950, (see Table IV). By way of contrast,

Table IV. Percent of the Population 65 Years Old and Over by Race, Residence and Sex, Mississippi, 1940 and 1950.

Residence and Race	Male		Female		Total	
	1940	1950	1940	1950	1940	1950
Total Population:						
White	5.5	7.0	5.5	7.6	5.5	7.3
Nonwhite	5.4	6.9	4.7	6.5	5.0	6.7
Total	5.5	6.9	5.1	7.1	4.3	7.0
Rural Farm:						
White	5.7	7.7	5.1	7.2	5.4	7.5
Nonwhite	5.2	6.6	4.2	5.4	4.7	6.0
Total	5.4	7.1	4.6	6.2	5.0	6.6
Rural Nonfarm:						
White	5.6	7.3	5.9	8.2	5.8	7.8
Nonwhite	6.5	8.8	6.7	9.5	6.6	9.2
Total	5.9	7.8	6.2	8.7	6.1	8.3
Urban:						
White	5.1	5.8	6.2	7.8	5.7	6.8
Nonwhite	5.1	6.4	5.4	7.0	5.3	6.7
Total	5.1	6.0	5.9	7.4	5.5	6.8

Source: U. S. Bureau of the Census, **U. S. Census of Population, 1950**, Vol. II, Part 24.

the smallest concentration of the elderly in 1950 (5.4 percent) occurred among nonwhite rural farm females. The same relative situation existed in 1940.

The supposition that large numbers of young persons are migrating away from rural farm areas in Mississippi is supported by figures compiled by Pedersen dealing with the age composition of out-migrants from these areas. He estimates that of the 490,405 persons who left rural farm areas between 1940 and 1950, 286,664 (or 58.5 percent) were in the most productive age group, namely, 15-35 years old.[2] In addition, many thousands in the 35-64 age range also transferred their residence. This shift is reflected in the ever-increasing age of farm operators. Extension workers, county agents and others whose concern it is to raise the level of living of rural people through improved agricultural and homemaking practices are going to have to contend increasingly with an aged farm population whose educational level has a tendency to decrease by virtue of the out-migration of the younger and better educated rural residents and who are for this reason, as well as by virtue of their age, less educable.

The data in Table V show that farm operators are more and more entering the upper age brackets and are not being replaced by younger men. Less than half as many farm operators were under 35 years of age in 1954 as in 1940. The number of farm operators under 25 years of age was nearly four times greater in 1950 than in 1954. Aged farm operators, however, have increased in both their number and the percent of all farm operators that their number represents, while there have been decreases in the number of farm operators in all other age groupings.

Farm and Nonfarm Changes

The data in Table VI show for Mississippi and for each of its counties the number of persons 65 years old and over by farm and nonfarm residence in 1940 and 1950. Also shown is the percent change in the farm and nonfarm residential status of these older people during the decade under consideration. In every county, except Hancock, aged persons increased more rapidly in numbers

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[2] Harald A. Pedersen, **Human Resources in Mississippi** (State College: Division of Sociology and Rural Life, Miississippi State College, 1957), p. 15.

Table V. Age of Mississippi Farm Operators, 1940 and 1954.

Age	1940		1954	
	Number*	Percent	Number*	Percent
Under 25	24,626	9.0	6,747	3.2
25-34	62,397	22.8	28,158	13.4
35-44	62,194	22.7	49,458	23.6
45-54	55,281	20.2	53,842	25.7
55-64	40,476	14.8	38,487	18.3
65 and over	28,834	10.5	32,947	15.7
Under 35	87,023	31.8	34,905	16.6
45 and over	124,591	45.5	124,916	59.6
Total	273,808	100.0	209,667	100.0

*Exclusive of those not reporting age, 6,248 in 1954 and 17,284 in 1940.

Source: U. S. Bureau of the Census, U. S. Census of Agriculture: 1954, Vol. 1, Part 22, Chapter A.

among the nonfarm than among the farm population. In seven counties in the state the aged nonfarm population not only increased by 100 percent or more from 1940 to 1950 but the aged farm population also registered a decrease. These counties are Tippah, Prentiss, Tishomingo, Sunflower, Carroll, Claiborne and Jefferson. The other 14 counties which doubled or more than doubled the number of the elderly in their nonfarm population during the decade also registered increases in the aged farm population.

Of the 21 counties in the state which registered increases in the aged nonfarm population of 100 percent or more, all but five had two-thirds or more of their population classified as farm in 1950. Thus, the growth of the aged nonfarm population seems to be greatest when the nonfarm population is relatively small and the farm population is correspondingly great. In addition, most of the counties containing large urban centers (10,000 inhabitants or more) registered increases of more than 75 percent in the aged nonfarm population from 1940 to 1950.

In 32 of the state's 82 counties, the aged farm residents decreased in numbers. In 28 of these counties, the decrease in the number of the aged in the farm population was accompanied by an increase of 50 percent or more in the number of the aged in the nonfarm category. In 19 of these 28 counties, the increase of the aged in the nonfarm category was by 75 percent or more. The increase of older people in Mississippi's population is slowest in the north central part of the state and most rapid in the southern and Delta areas.

Table VI. Number of Persons 65 Years Old and Over by Farm and Nonfarm Residence, 1940 and 1950, and Percent Change 1940 and 1950, for Counties, Mississippi.

County	Number of Persons				Percent Change	
	Farm		Nonfarm		1940 to 1950	
	1940	1950	1940	1950	Farm	Nonfarm
State	70,304	72,766	45,114	80,198	3.5	77.8
Adams	616	439	1,282	1,859	-28.7	45.0
Alcorn	839	828	710	1,385	-1.3	95.1
Amite	926	901	221	425	-2.7	92.3
Attala	1,198	1,221	502	872	1.9	73.7
Benton	507	545	83	135	7.5	62.7
Bolivar	2,203	2,220	1,054	2,191	0.8	107.9
Calhoun	749	870	273	476	16.2	74.4
Carroll	957	903	168	343	-5.6	104.2
Chickasaw	764	859	478	673	12.4	40.8
Choctaw	588	612	163	341	4.1	109.2
Claiborne	662	490	242	534	-26.0	120.7
Clarke	882	836	367	702	-5.2	91.3
Clay	725	695	487	796	-4.1	63.4

County	Number of Persons				Percent Change	
	Farm		Nonfarm		1940 to 1950	
	1940	1950	1940	1950	Farm	Nonfarm
Coahoma	1,442	1,758	933	1,724	21.9	84.8
Copiah	1,288	1,146	743	1,376	-11.0	85.2
Covington	654	681	178	424	4.1	138.2
DeSoto	1,286	1,470	228	379	14.3	66.2
Forrest	454	444	1,362	2,310	-2.2	69.6
Franklin	498	452	266	452	-9.2	69.9
George	256	299	161	331	16.8	105.6
Greene	260	239	166	276	-8.1	66.3
Grenada	589	550	465	766	-6.6	64.7
Hancock	107	176	670	850	64.5	26.9
Harrison	368	330	2,764	4,131	-10.3	49.5
Hinds	1,934	1,544	3,500	6,579	-20.2	88.0
Holmes	1,352	1,442	734	1,177	6.7	60.4
Humphreys	733	800	256	505	9.1	97.4
Issaquena	329	310	47	72	-5.8	53.2
Itawamba	893	912	64	374	2.1	484.4
Jackson	200	245	961	1,633	22.5	69.9
Jasper	819	1,003	169	406	22.5	140.2
Jefferson	807	769	203	433	-4.7	113.3
Jefferson Davis	652	793	79	197	21.6	149.4
Jones	889	1,021	1,225	2,283	14.8	86.4
Kemper	1,051	955	168	284	-9.1	69.0
Lafayette	980	1,072	366	630	9.4	72.1
Lamar	334	455	298	447	36.2	50.0
Lauderdale	1,050	983	2,247	3,959	-6.4	76.2
Lawrence	525	569	166	284	8.4	71.1
Leake	929	1,189	214	382	28.0	78.5
Lee	1,303	1,364	883	1,646	4.7	86.4
Leflore	1,243	1,418	1,018	1,752	14.1	72.1
Lincoln	990	961	600	1,101	-2.9	83.5
Lowndes	988	921	969	1,716	-6.8	77.1
Madison	1,340	1,405	605	1,125	4.9	85.9
Marion	647	767	332	688	18.5	107.2
Marshall	1,107	1,207	417	592	9.0	42.0
Monroe	1,514	1,216	871	1,585	-19.7	82.0
Montgomery	629	640	366	634	1.7	73.2
Neshoba	975	1,021	245	565	4.7	130.6
Newton	982	1,069	370	617	8.9	66.8
Noxubee	1,103	997	305	526	-9.6	72.5
Oktibbeha	842	776	386	767	-7.8	98.7
Panola	1,349	1,535	410	930	13.8	126.8
Pearl River	420	551	476	680	31.2	42.9
Perry	286	300	198	315	4.9	59.1
Pike	818	778	1,191	1,837	-4.9	54.2
Pontotoc	1,009	1,150	286	557	14.0	94.8
Prentiss	806	795	289	617	-1.4	113.5
Quitman	771	1,008	245	479	30.7	95.5
Rankin	907	967	706	1,365	6.6	93.3
Scott	847	919	326	634	8.5	94.5
Sharkey	526	553	133	298	5.1	124.1
Simpson	806	969	292	576	20.2	97.3
Smith	653	822	136	252	25.9	85.3
Stone	196	228	190	264	16.3	38.9
Sunflower	1,851	1,713	611	1,323	-7.5	116.5
Tallahatchie	1,152	1,242	404	696	7.8	72.3
Tate	868	915	228	465	5.4	103.9
Tippah	792	728	280	623	-8.1	122.5
Tishomingo	668	626	293	635	-6.3	116.7
Tunica	921	1,144	168	246	24.2	46.4
Union	904	1,042	396	705	15.3	78.0
Walthall	614	709	96	197	15.5	105.2
Warren	663	565	1,907	2,921	-14.8	53.2
Washington	1,481	1,731	1,712	3,035	16.9	77.3
Wayne	571	638	297	462	11.7	55.6
Webster	626	680	210	359	8.6	71.0
Wilkinson	748	550	255	508	-26.5	99.2
Winston	804	954	264	604	18.7	128.8
Yalobusha	831	772	418	695	-7.1	66.3
Yazoo	1,458	1,394	667	1,210	-4.4	81.4

Sources: U. S. Bureau of the Census, **U. S. Census of Population: 1950**, Vol. II, Part 24, Tables 41 and 49; and **U. S. Census of Population: 1940**, Vol. II, Part 4, "Mississippi", Tables 27 and 28.

Size of Community

When nonfarm areas are sorted by size it is apparent that not all of them experienced the same rate of increase in their aged population from 1940 to 1950, (Table VII).[3] The greatest increases in the number of the elderly occurred in the two extremes of the nonfarm continuum; in places of less than 1,000 inhabitants and in places of 10,000 or more population. In places of less than 1,000 inhabitants, including nonfarm residents in open country areas, the aged population increased 90.5 percent during the decade. Almost as spectacular was the rate at which the aged increased in urban centers of more than 10,000 inhabitants, 76.4 percent.

The proportionate gain of aged females was in all instances greater than that of their male counterparts, excepting places of 10,000 or more population where this trend was slightly reversed. This higher percentage increase of aged females over aged males was particularly great among the rural farm population. Places of intermediate size (1,000-2,500 and 2,500-10,000) also showed considerable proportionate increases in the number of the elderly in the decade preceding 1950.

A comparison of the relative distribution of the aged and of the total population in 1940 and in 1950 is made in Table VIII. In both 1940 and 1950 rural farm areas contained a larger proportion of the total than of the aged inhabitants. The reverse was true, however, for those places of under 1,000-2,500 and 2,500-10,000, all of which contained more than their proportionate share of the elderly. In both years, cities of 10,000 inhabitants or more contained a smaller proportion of the aged than of the total population. When corresponding percentages for 1940 and 1950 are compared, it is clear that both the aged and the total population are becoming more concentrated in rural nonfarm and urban areas at the expense of rural farm areas. Nearly one-fifth of the elderly resided in places of less than 1,000 in 1950 whereas only a little over one-tenth did so in 1940. In 1940 urban places contained one-fifth of the aged. In 1950 those places were the residence

Table VII. Number and Percent Change in the Population 65 Years Old and Over, 1940-1950, in Places of Given Size Categories in 1940, by Sex, Mississippi.

Size Category	Males		Females		Total	
	Number Change	Percent Change	Number Change	Percent Change	Number Change	Percent Change
Rural Farm	560	1.4	1,902	6.0	2,462	3.5
Rural Nonfarm:						
Under 1,000	6,560	86.9	7,814	93.7	14,374	90.5
1,000-2,500	1,519	60.6	2,003	69.2	3,522	65.2
Urban:						
2,500-10,000	2,378	55.7	3,523	64.0	5.901	60.4
10,000 & over	4,411	77.1	5,930	75.8	10,341	76.4
Total	15,428	26.2	21,172	37.7	36,600	31.9

Source: U. S. Bureau of Census, **U. S. Census of Population: 1950**, Vol. II, Part 24; **1940**, Vol. II, Part 4.

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[3] Totals in this table are slightly at variance with those to be found elsewhere in the paper because of the exclusion of two small centers. Electric Mills and East Tupelo, for which data were not available for 1940 and 1950. The 1,000-2,500 category is not a pure rural nonfarm category since a few rural farm residents are to be found in centers of this size. However, their proportion of the total population of these centers (3.3 percent in 1940 and 2.8 percent in 1950) is so small as to affect the results of the computations but little.

Table VIII. Number and Percent of Persons 65 Years Old and Over and of the Total Population in Places of Given Size Categories, Mississippi, 1940-1950.

Size Category	Total Pop., 1940		Aged Pop., 1940		Total Pop., 1950		Aged Pop., 1950	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Rural Farm	1,339,884	64.1	70,304	60.9	1,097,207	50.3	72,766	47.6
Rural Nonfarm:								
Under 1,000	263,225	12.1	15,825	13.7	358,718	16.5	29,471	19.3
1,000-2,500	87,805	4.0	5,466	4.7	115,827	5.3	9,716	6.3
Urban:								
2,500-10,000	159,772	7.3	9,768	8.5	185,283	8.5	14,850	9.7
10,000 and over	273,110	12.5	14,055	12.2	421,879	19.4	26,155	17.1
Total	2,183,796	100.0	115,418	100.0	2,178,914	100.0	152,964	100.0

Source: U. S. Bureau of the Census, **U. S. Census of Population: 1950,** Vol. II, Part 24; **1940,** Vol. II, Part 4.

of more than one-quarter of that group.

Tables IX, X, XI contain information on the growth in the number of the aged population in all Mississippi communities with a population of 1,000 or more in 1940 for which 1950 data were also available. One hundred and four places are included. In none of these was there a decrease in the total number of the aged from 1940 to 1950. Only one decrease (of two females in Tunica) was observed. The very sizable range of the percentage increase in the total aged can be seen in these tabulations. Both the smallest (15.1 percent) and the largest (231.3 percent) percentage changes occurred in places having from 1,000 to 2,500 inhabitants. However, since the aged populations of these places are small, a small numerical change can greatly affect the proportionate change.

The three cities in the highest population category (10,000 and over) having an increase in the aged population of over 90 percent were all located in the Delta. These were Clarksdale (104.3 percent), Greenville (100.9 percent), and Greenwood (94.5 percent). On the other hand, of the six cities in the 2,500-10,000 category experiencing similar gains in the aged populations, only one was located in the Delta. The remainder are located in the north central and northeastern portions of the state.

Age

Table XII presents in a modified form the results of a tabulation of percentage changes in the elderly from 1940 to 1950, by race, residence, sex, and age, for Mississippi. In order to facilitate comparison of these several factors, the various percentage increases have been converted into index numbers with the total percentage increase in the aged for the state (32.5 percent) equal to 100. Thus, when the percentage change in the aged in a given category is greater than the figure for the total aged, the resulting index number is larger than 100, and when it is smaller, the index number is smaller than 100. When there has been no increase from 1940 to 1950, the index will show as a zero; but when there has been an absolute loss of persons in the class, the index will show a minus value. Had all the percentage increases been evenly distributed throughout the racial, residential, sex, and age categories, the index numbers would all be 100.

That this is not the case is made evident by the data in Table XII. Persons 65 years old and over in the rural farm population increased much more slowly than persons 65 years old and over in the state as a whole. In the rural nonfarm and urban populations, the increase in the numbers of persons 65 years old and over were more than twice greater than in the state as a whole.

Of particular interest are the low index numbers for the 65 to 69 age group. Particularly noticeable here are the decreases registered by all categories of the rural farm population. Indeed, the differing rates of increase of the aged, as between the farm and nonfarm population of the state, is most clearly shown here. Not one index number for the rural farm population is above 100, and not one for the rural nonfarm or urban population is below 100.

Also noticeable for their low rate of increase is the 85 and over age group. Among both white and nonwhite males and females, this group increased more slowly than the total aged population. On the other hand, with the exception of a few instances among the nonwhite urban population the 70-74 and 75-84 age groups increased in numbers more rapidly than either of the age groups immediately above or below, (65-69 and 85 and over).

Table IX. Number and Percent Change in the Population 65 Years Old and Over, 1940-1950, of Places with 1,000-2,500 Inhabitants in 1940, by Sex, Mississippi.*

Place	Males		Females		Total	
	Number Change	Percent Change	Number Change	Percent Change	Number Change	Percent Change
Ackerman	20	33.3	24	42.1	44	37.6
Baldwyn	37	90.2	37	72.5	74	80.4
Batesville	25	73.5	57	183.9	82	126.2
Bay Springs	22	66.7	32	139.1	54	96.4
Booneville	53	84.1	86	114.7	139	100.7
Brandon	19	61.3	13	36.1	32	47.8
Bruce	20	100.0	29	193.3	49	140.0
Bude	10	37.0	14	60.9	24	48.0
Calhoun City	13	48.1	18	46.2	31	47.0
Carthage	42	110.5	38	100.0	80	105.3
Centerville	42	107.7	51	81.0	93	91.2
Charleston	34	49.3	67	85.9	101	68.7
Collins	13	30.2	27	90.0	40	54.8
Crosby	6	85.7			6	31.6
Drew	31	96.9	32	94.1	63	95.5
Edwards	2	4.2	20	28.2	22	18.5
Eupora	29	80.6	32	76.2	61	78.2
Fulton	39	278.6	35	194.4	74	231.3
Gloster	37	112.1	26	41.3	63	65.5
Hernando	23	65.7	17	30.9	40	44.4
Hollandale	58	161.1	65	138.3	123	148.2
Houston	8	13.6	23	43.4	31	27.7
Itta Bena	35	55.6	31	33.3	66	42.3
Iuka	11	15.9	17	20.0	28	18.2
Lambert	39	134.5	21	55.3	60	89.6
Long Beach	49	102.1	57	80.3	106	89.1
Lucedale	14	45.2	22	71.0	36	58.1
Lumberton	16	28.6	23	35.6	39	32.5
Macon	12	17.4	58	70.7	70	46.4
Magee	38	146.2	39	156.0	77	151.0
Magnolia	9	12.7	13	17.3	22	15.1
Marks	23	41.8	53	96.4	76	69.1
Mendenhall	20	45.5	25	71.4	45	57.0
Moorhead	47	109.3	32	72.7	79	90.8
Newton	23	39.7	39	56.5	62	48.8
Ocean Springs	42	58.3	69	101.5	111	79.3
Okolona	28	32.9	29	27.9	57	30.2
Pontotoc	10	13.9	20	25.3	30	19.9
Poplarville	16	25.4	41	85.4	57	51.4
Purvis	10	31.3	22	100.0	32	59.3
Quitman	33	94.3	26	72.2	59	83.1
Ripley	67	136.7	45	58.4	112	88.9
Rolling Fork	26	118.2	16	50.0	42	77.8
Rosedale	38	82.6	57	83.8	95	83.3
Ruleville	42	120.0	26	72.2	68	95.8
Sardis	18	32.1	34	42.5	52	38.2
Senatobia	26	49.1	48	60.8	74	56.1
Shaw	49	74.2	70	81.4	119	78.3
Shelby	48	102.1	74	104.2	122	103.4
Summit	15	24.2	26	46.4	41	34.7
Tunica	-2	-5.7	21	50.0	19	24.1
Tylertown	24	64.9	28	75.7	52	70.3
Union	7	15.2	40	114.3	47	58.0
Waynesboro	77	248.4	81	180.0	158	207.9
Wiggins	21	65.6	35	140.0	56	98.2
Woodville	5	12.5	22	44.9	27	30.3
Total	1,519	60.6	2,003	69.2	3,522	65.2

*Excludes East Tupelo and Electric Mills for which 1950 data were not available.

Source: U. S. Bureau of the Census, **U. S. Census of Population**: 1950, Vol. II, Part 24; 1940, Vol. II, Part 4.

Table X. Number and Percent Change in the Population 65 Years Old and Over, 1940-1950, of Places with 2,500 to 10,000 Inhabitants in 1940, by Sex, Mississippi.

Place	Males		Females		Total	
	Number Change	Percent Change	Number Change	Percent Change	Number Change	Percent Change
Aberdeen	62	38.3	63	25.8	125	30.8
Amory	83	78.3	106	76.8	189	77.5
Bay St. Louis	36	24.3	58	33.3	94	29.2
Belzoni	59	70.2	63	78.8	122	74.4
Brookhaven	85	53.1	92	40.7	177	45.9
Canton	78	42.2	113	45.9	191	44.3
Cleveland	91	119.7	134	126.4	225	123.6
Columbia	60	51.3	100	90.1	160	70.2
Corinth	220	101.4	245	91.1	465	95.7
Crystal Springs	45	48.9	75	57.7	120	54.1
Durant[1]	40	54.8	50	48.1	90	50.8
Ellisville	6	8.1	32	39.0	38	24.4
Forest	30	45.5	48	65.8	78	56.1
Grenada	42	26.1	121	64.7	163	46.8
Hazlehurst	14	14.3	57	44.2	71	31.3
Holly Springs	6	6.4	44	35.2	50	22.8
Indianola	29	22.7	88	62.4	117	43.5
Kosciusko	132	136.1	160	94.7	292	109.8
Leland	54	66.7	96	109.1	150	88.8
Lexington	33	32.4	58	47.5	91	40.6
Louisville	79	101.3	132	151.7	211	127.9
McComb[2]	123	46.1	185	56.7	308	51.9
Moss Point	42	45.7	48	48.5	90	47.1
New Albany	45	50.0	91	73.4	136	63.6
Oxford	45	47.9	57	37.3	102	41.3
Pass Christian	39	38.6	32	23.0	71	29.6
Pascagoula[2]	90	69.2	118	79.7	208	74.8
Philadelphia	74	105.7	66	78.6	140	90.9
Picayune	66	71.0	62	66.0	128	68.4
Port Gibson	58	92.1	66	62.3	124	73.4
Starkville	30	24.4	70	38.7	100	32.9
Tupelo[2]	184	92.9	268	113.6	452	104.1
Water Valley	48	34.3	66	37.7	114	36.2
West Point	65	43.0	130	53.3	195	49.4
Winona	53	63.1	89	77.4	142	71.4
Yazoo City	132	77.2	240	97.2	372	89.0
Total	2,378	55.7	3,523	64.0	5,901	60.4

[1] Had less than 2,500 inhabitants in 1950.

[2] Had more than 10,000 inhabitants in 1950.

Source: U. S. Bureau of the Census, **U. S. Census of Population: 1950,** Vol. II, Part 24; 1940, Vol. II, Part 4.

Table XI Number and Percent Change in the Population 65 Years Old and Over, 1940-1950, of Places with 10,000 or More Inhabitants in 1940, by Sex and Race, Mississippi.

Place and Race	Males		Females		Total	
	Number Change	Percent Change	Number Change	Percent Change	Number Change	Percent Change
Biloxi:						
White	219	56.6	163	34.8	382	44.7
Nonwhite	34	60.7	45	53.8	79	56.4
Total	253	57.1	208	37.7	461	46.3
Clarksdale:						
White	126	151.8	168	142.4	294	146.3
Nonwhite	147	86.5	165	78.6	312	82.1
Total	273	107.9	333	101.5	606	104.3
Columbus:						
White	87	51.2	165	65.0	252	59.4
Nonwhite	69	44.2	124	66.0	193	56.1
Total	156	47.9	289	65.4	445	57.9
Greenville:						
White	166	114.5	210	104.5	376	108.7
Nonwhite	258	89.3	361	101.8	619	96.7
Total	424	97.7	571	103.4	995	100.9
Greenwood:						
White	57	38.5	169	95.5	226	69.5
Nonwhite	163	117.3	208	123.8	371	120.8
Total	220	76.7	377	109.3	597	94.5
Gulfport:						
White	244	86.8	254	85.8	498	86.3
Nonwhite	50	61.0	48	60.8	98	60.9
Total	294	81.0	302	80.5	596	80.8
Hattiesburg:						
White	221	75.7	315	84.7	536	80.7
Nonwhite	93	60.8	115	66.9	208	64.0
Total	314	70.6	430	79.0	744	75.2
Jackson:						
White	629	97.4	904	80.9	1,533	86.9
Nonwhite	455	116.1	506	90.5	961	101.1
Total	1,084	104.4	1,410	84.1	2,494	91.9
Laurel:						
White	199	95.7	231	77.8	430	85.1
Nonwhite	106	74.1	87	58.4	193	66.1
Total	305	86.9	318	71.3	623	78.2
Meridian:						
White	384	68.2	593	77.1	977	73.3
Nonwhite	128	46.9	213	63.6	341	56.8
Total	512	61.2	806	73.0	1,318	67.9
Natchez:						
White	88	50.3	162	65.6	250	59.2
Nonwhite	109	54.2	189	53.4	298	53.7
Total	197	52.4	351	58.4	548	56.1
Vicksburg:						
White	182	72.8	278	68.0	460	69.8
Nonwhite	197	61.6	257	57.9	454	59.4
Total	379	66.5	535	62.7	914	64.2
Total:						
White	2,602	77.7	3,612	76.4	6,214	77.0
Nonwhite	1,809	76.2	2,318	74.9	4,127	75.5
Total	4,411	77.1	5,930	75.8	10,341	76.4

Source: U. S. Bureau of the Census, U. S. Census of Population: 1950, Vol. II, Part 24; 1940, Vol. II, Part 4.

Table XII. Index of Percent Change in the Population 65 Years Old and Over by Race, Residence, Sex, and Age, Mississippi, 1940-1950. Mississippi == 100 (32.5 percent increase)

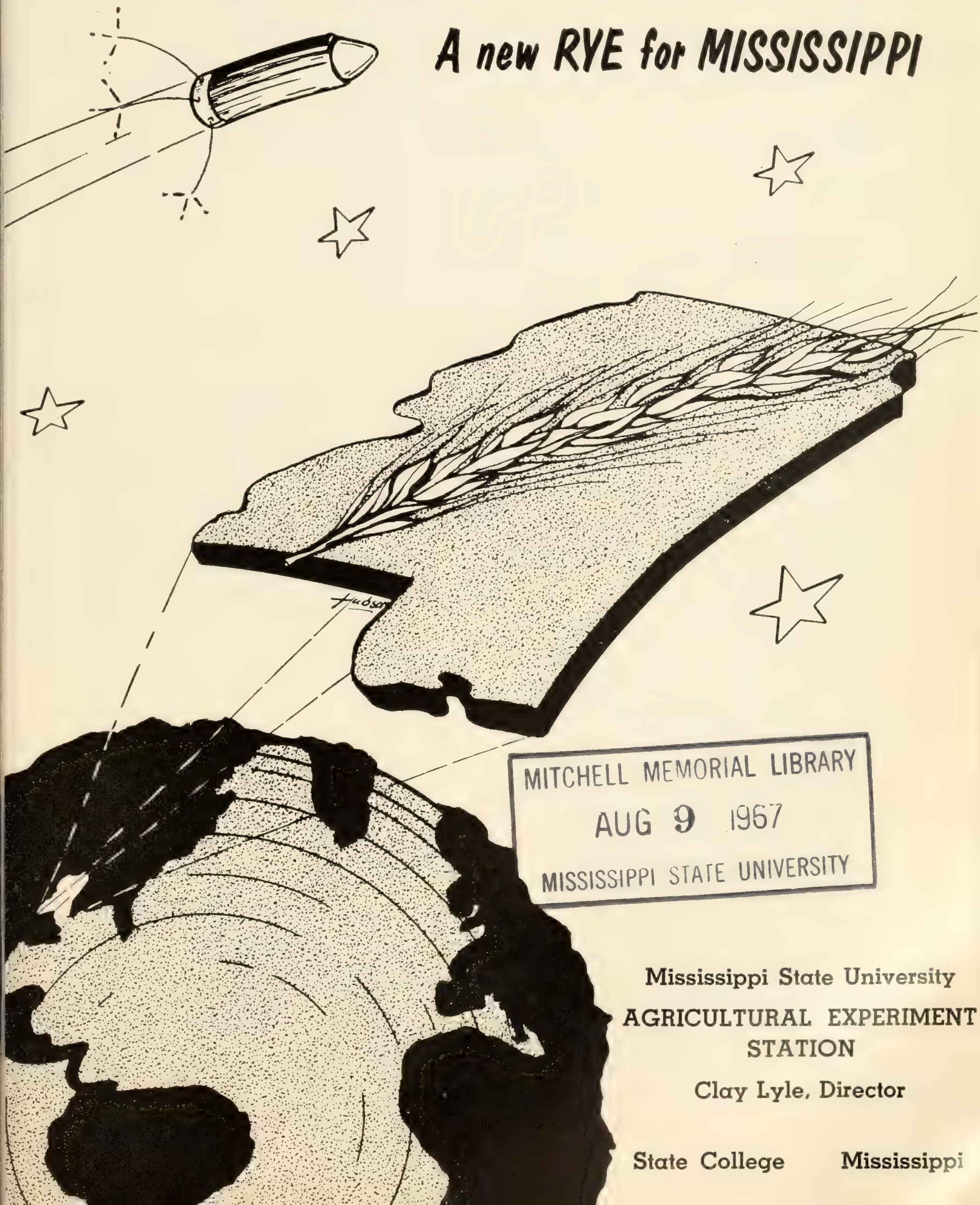
Characteristic	Rural Farm			Rural Nonfarm			Urban			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Total Population:												
65-69	-25	5	12	168	230	199	152	193	174	37	93	64
70-74	14	24	18	274	311	293	217	229	224	95	134	113
75-84	74	58	66	394	338	365	369	309	333	183	176	179
85 and over	-41	-35	-38	176	140	155	181	199	192	37	48	43
All 65 and over	4	18	11	247	274	261	213	229	222	82	119	100
White:												
65-69	-9	10	-1	164	212	189	142	187	167	56	101	78
70-74	51	73	61	280	332	306	239	368	255	138	188	162
75-84	75	92	82	393	358	374	378	319	342	198	216	207
85 and over	-2	-10	-7	205	143	154	208	231	223	85	71	85
All 65 and over	25	43	33	249	274	262	217	243	232	110	150	129
Nonwhite:												
65-69	-29	1	-22	174	252	216	165	202	185	17	84	48
70-74	-19	-22	120	261	278	271	183	166	174	47	68	57
75-84	73	22	49	297	307	349	355	291	318	164	124	144
85 and over	-65	-20	-57	148	136	141	152	161	158	1	18	11
All 65 and over	-14	-5	-10	245	261	254	205	208	207	52	84	65

Source: U. S. Bureau of the Census, **U. S. Census of Population: 1950**, Vol. II, Part 24, **1940**, Vol. II, Part 4.

BULLETIN 600 JULY 1960

EXPLORER...

A new RYE for MISSISSIPPI



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EXPLORER—A NEW RYE FOR MISSISSIPPI

By B. S. BARNES and D. G. WELLS[1]

Explorer is the name given a new Abruzzi-type leaf rust resistant, high grain and forage yielding rye developed by Dr. D. G. Wells of the Mississippi Agricultural Experiment Station.

Explorer was developed to meet the need of Mississippi farmers for a small grain which would remain green and in good pasture grazing condition throughout the winter and also to give a spring grain crop either for livestock feeding or as a cash crop.

Rye is the most winter hardy of the small grains and it is an excellent pasture crop that makes quick growth in the fall and early spring. However, rye has not been utilized extensively in Mississippi in the years past, due primarily to the lack of an adapted strain that is resistant to leaf rust, the most important disease of rye.

One of the outstanding characteristics of Explorer is its high degree of resistance to leaf rust. Other attributes of Explorer are:

- It yields well under cold conditions
- Has good test weight
- Possesses light colored seeds
- Provides good fall, winter and early spring grazing
- Has good straw strength
- Is of average maturity

Head and seed of Explorer rye.

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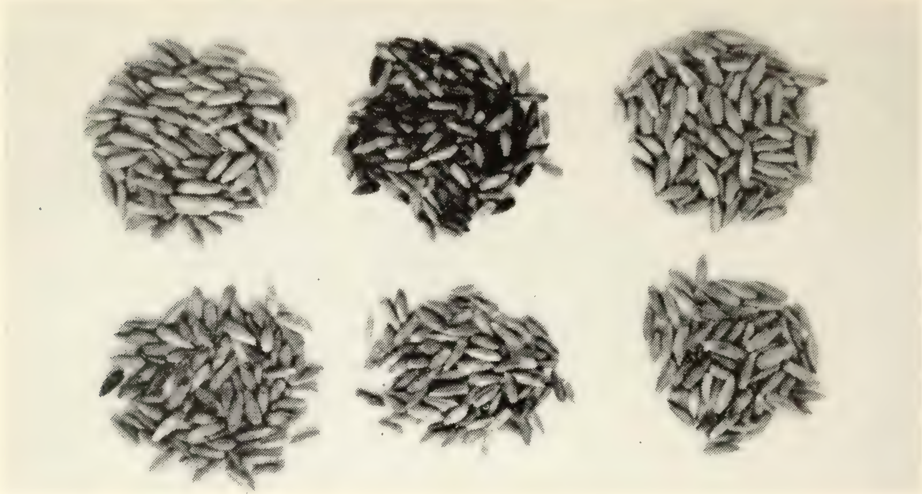
[1] Assistant Agronomist and Agronomist respectively, Department of Agronomy, Mississippi Agricultural Experiment Station.

Thanks are due W. J. Drapala and N. C. Merwine for reviewing the manuscript.



Seed of six commercial rye strains. Top row (left to right) Explorer, Florida Black, Elbon. Bottom row (left to right) Gator, Balbo, Woods Abruzzi.

Development

Explorer is a synthetic strain developed by bulking the seed of five inbred lines which had been selected for resistance to leaf rust, resistance to lodging, and light colored seed types. In Autumn of 1953, seeds of six S_2 lines were sown in small pots in the greenhouse. Six different synthetics were made from the six inbred lines by combining five inbreds at a time. Thus, each inbred did not appear in one of the six combinations but did appear in all others. Each 5-line synthetic was transplanted to an isolated plot where it was allowed to open pollinate for production of the synthetic strains.

Results From Field Tests

Tests of adaptation, yielding ability, and disease resistance of Explorer and other commercial rye strains have been conducted at all Branch Stations[2] in Mississippi and in eight Southern states comprising 24 locations. Explorer was first extensively and successfully tested in comparison with other rye strains in the 1955-56 crop year when it was grown at most Branch Stations in Mississippi and in Uniform Southern Rye Nurseries over the Southern states.

Table 1 shows the relative grain yielding ability of Explorer and other commercial rye strains at Experiment Stations in Mississippi.

In Table 2, grain yields of Explorer are compared with other commercial strains of rye in Uniform Southern Rye Nurseries from eight Southern States.

Yields of forage in pounds of dry matter per acre are summarized in Table 3 for Explorer and other rye strains from Mississippi Branch Experiment Stations.

In Table 4, forage yields of rye are presented from regional nurseries. Explorer has been a consistently high grain and forage yielder in Mississippi and other Southern states as shown by its superior rank in all tests.

Agronomic Characteristics

Maturity: Explorer is of intermediate maturity; it heads and matures earlier than Balbo and later than Florida Black, usually about the same time as Woods and Wrens Abruzzi.

---

[2] Branch Station personnel who aided in testing the performance of Explorer are B. L. Arnold, B. C. Hurt, Jr., R. C. Albritton, D. H. Bowman, L. B. Walton, B. C. Murphy, R. E. Coats, and C. L. Blount.

Test Weight, Lodging and Plant Height: In tests at Mississippi Branch Stations for the period 1956-58, Explorer averaged two pounds more in test weight per bushel than the five strains with which it was compared. However, Explorer did not retain this weight per bushel superiority in regional nurseries in the Southern states. In height of straw and resistance to lodging, Explorer is similiar to other strains.

Leaf Rust Resistance

One of the outstanding characteristics of Explorer is its resistance to leaf rust. In the

Table 1. Grain yields of rye in bushels per acre at experiment stations in Mississippi.

Variety	1956	1957	1958	Mean	Rank
Explorer	30.4	26.3	25.3	27.3	1
*Miss. Sel. of Abruzzi	30.7	23.7	22.6	25.7	2
Gator	26.5	18.0	25.0	23.2	3
Woods Abruzzi	27.1	16.7	22.5	22.1	4
Balbo	28.2	13.8	24.0	22.0	5
Elbon	-----	25.4	29.5	-----	-
Stations	7	6	5	-----	--

*A selection of Abruzzi made by Dr. D. G. Wells but not released as a commercial strain.

Table 2. Grain yields of rye in bushels per acre at Experiment Stations in the Southern states.*

Variety	1956	1957	1958	Mean	Rank
Explorer	38.6	29.5	33.7	33.9	1
Gator	33.6	26.5	30.1	30.1	3
Elbon	-----	-----	36.4	-----	--
Wrens Abruzzi	29.4	24.4	25.9	26.6	6
Woods Abruzzi	35.5	18.9	30.2	28.2	5
Florida Black	25.3	20.3	24.9	23.5	7
Balbo	37.8	17.2	34.8	29.9	4
Miss. Sel.	37.8	28.5	30.1	32.1	2
Stations	16	13	17		

*With the permission of those concerned, data presented in this table and other tables were taken from the 1956-58 Uniform Rye Nurseries reports compiled by Dr. D. G. Wells of the Mississippi Agricultural Experiment Station.

Table 3. Forage yields of rye in tons of dry matter per acre at two Mississippi Stations.

Variety	1956	1957	1958*	Mean	Rank
Explorer	2.05	2.62	1.98	2.22	1
Miss. Sel.	2.04	2.36	1.48	1.96	2
Woods Abruzzi	1.91	2.16	1.69	1.92	3
Gator	2.05	2.10	1.48	1.88	4
Balbo	1.06	1.94	1.84	1.61	5
Elbon	-----	-----	1.57	-----	-

*Results of one station only.

Table 4. Forage yields of rye in tons of dry matter per acre at Experiment Stations in the Southern states.

Variety	1956	1957	1958	Mean	Rank
Explorer	1.60	2.28	1.40	1.76	1
Gator	1.34	1.85	1.14	1.44	5
Elbon	-----	-----	1.24	-----	-
Wrens Abruzzi	1.61	1.83	1.23	1.55	3
Woods Abruzzi	1.35	1.89	1.29	1.51	4
Florida Black	1.54	1.65	1.02	1.40	6
Balbo	.98	1.74	1.23	1.32	7
Miss. Sel.	1.48	2.12	1.10	1.57	2
Stations	6	3	11		

the 1956-57 season, which was most favorable one for rust development in many years, results from nine Southern stations indicated that Explorer had a leaf rust severity reading of 23.5% as compared with 66.4% for Woods, 41.3% for Wrens, 75.0% for Balbo, and 40.0% for Elbon. The only commericial rye more resistant than Explorer is Gator which is not as well adapted above the deep South as is Explorer. Its reaction to anthracnose, leaf blotch, scorch, and scald is indistinguishable from other strains.

Seed Availability

Foundation and registered seed of Explorer is being increased and it is expected that there will be a sufficient supply of each class of certified seed available to certified growers for 1960 fall planting. Inquiries for foundation seed should be addressed to the Manager, Foundation Seed Stocks, Box 97, State College, Mississippi. Inquiries for an approved list of growers of other classes of certified seed should be addressed to Mississippi Seed Improvement Association, State College, Mississippi.

Table 5. Comparisons of agronomic characteristics of Explorer rye with other strains of commercial importance over the Southern states.

Variety	Lodging 20 station-yrs.	Test weight 28 station-yrs.	Plant height 20 station-yrs.	Date 1/10 headed 16 station-yrs.
	%	lbs/bu	in.	
Explorer	18	53.1	56	3/24
Gator	10	52.7	57	3/23
Elbon	*24	**54.3	**58	**3/26
Wrens Abruzzi	15	53.2	55	3/19
Woods Abruzzi	24	52.8	56	3/25
Florida Black	16	53.1	53	3/14
Balbo	23	51.4	57	4/3
Miss. Sel.	14	52.9	57	3/26

*1958 data only
**1957-1958 data only

ACKNOWLEDGEMENTS

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Forage growth of Explorer rye in January.

Foundation field of Explorer rye.

BULLETIN 601 JULY, 1960

Grain Marketing Problems in Mississippi

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SUMMARY AND CONCLUSIONS

Efficient marketing of grain cannot be accomplished without adequate facilities for handling the quantity produced, for drying to safe storage levels of moisture content and for protecting quality while in storage.

Increases in grain production, movement of a larger proportion of production through marketing channels, feeding of larger quantities of grain by specialized livestock producers and greater participation in Commodity Credit Corporation programs have increased the need for grain storage facilities in Mississippi.

Observation indicates that some kind of storage is always available for all of the grain that is harvested. However, much of the storage that is available is of such poor quality that grain stored in it is either lost or reduced in value by damage from weather, rodents and insects. Frequently, facilities are not available for drying grain and for controlling moisture while grain is in storage. Severe losses from moisture damage of stored grain are the result.

Inventories of grain storage facilities support these conclusions. The total grain storage capacity in Mississippi as of mid-year 1958 exceeded storable supplies in any recent year. However, only 20.3 million bushels of the total grain storage capacity was available to farmers for long-time storage. Furthermore, the 15 million bushels of on-farm storage suitable for long-time storage was not completely effective because on-farm facilities for handling high-moisture grain were severely limited.

The capacity of grain storage facilities available to farmers and suitable for long-time storage is significantly less than storable supplies. The situation is most critical for small grains in the fall harvest period. In the fall of 1958, for example, the carry-over of oats plus the production of soybeans exceeded by 7.2 million bushels the capacity of adequate small grain storage available to farmers.

Prices at harvest relative to support prices, seasonal price increases and costs of storing have provided opportunities for substantial income from storage of the more important grains in seven of the last ten years. Opportunities for income from storage can be expected to continue so long as storage facilities are inadequate.

Where commercial storage facilities are not available, storage can be done only on the farm. On-farm drying and storage facilities require little initial capital outlay on the part of the farmer. The Commodity Credit Corporation makes loans to farmers to finance new farm storage facilities for grains. Such loans may be up to as much as 80 percent of the cost of facilities and are payable in four annual installments at an interest rate of 4 percent. Also, the Commodity Credit Corporation provides farmers an opportunity for storage income by offering reseal programs through which price support loans may be continued.

An Economic Evaluation of Grain Marketing Problems in Mississippi

by

CHESTER M. WELLS, JR. and BARNEY H. JACKS

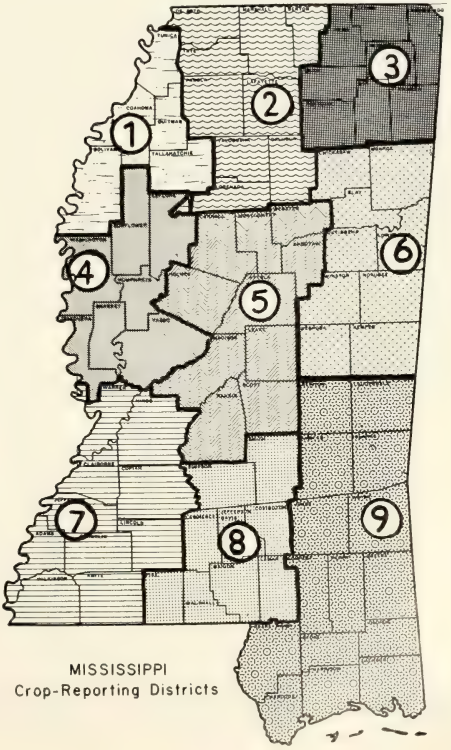
INTRODUCTION

Problems in the marketing of grain have become greater within the past decade because of the increase in volume marketed. The increase in volume marketed has resulted from movement through marketing channels of larger proportions of an expanded production.

The problems resulting from the increase in volume marketed have been intensified by changes in farm technology. The increased use of mechanical harvesters has accelerated the rate of movement of grain to market. Frequently, grain that has moved to market early in the season has contained too much moisture for safe storage.

Efficient marketing of grain cannot be accomplished without adequate facilities for handling the quantity produced, for drying to safe storage levels of moisture content and for protecting quality while in storage. Producers can provide these facilities for themselves or can depend on commercial drying and storage. In either case, the cost of drying and storage is borne by the producer. Normally, if commercial drying and storage facilities in an area are not adequate, these services can be provided by farmers at a cost that is less than the price discounts that have been experienced by producers who have been forced to sell immediately after harvest.

The purpose of this study was to estimate the extent by which storable supplies of grain exceed facilities for drying and storing in Mississippi. The capacity and quality of commercial storage facilities were determined by enumeration of all known facilities. Data on farm storage facilities were obtained by the Mississippi Crop and Livestock Reporting Service by enumeration of a representative sample of farms. Where possible, estimates are by crop reporting districts, the smallest geographic sub-divisions of the state for which data were available. This geographic stratification will make the findings of greater usefulness to farmers, marketing firms and public and private organizations in evaluating alternative courses of action to improve the grain marketing system in the state.



MISSISSIPPI
Crop-Reporting Districts

PRODUCTION, ACREAGE AND YIELDS OF GRAIN

Production of grains[1] in Mississippi has increased in the last two decades. Although slightly less than the peak production attained in 1955, production in 1959 was 60 percent greater than the annual average production of 46 million bushels in 1935-39 (Tables 1 and 2). Increases have been significant in all Crop Reporting Districts except District 7.

The production of small grains has increased relative to the production of corn, but corn production still exceeds the total production of small grains (Table 2). Average annual corn production was less in 1950-54 than in 1935-39. However, in each year since 1954, corn production has exceeded the 1950-54 average. The greatest increases in production of small grains over the same period have been in soybeans and wheat, both of which are produced primarily for the cash market. Production of these two crops has been concentrated in the Delta. The production of individual grain crops by Crop Reporting Districts is shown in Appendix tables 1-3.

Acreages

Increases in grain production have been achieved in spite of decreases in acreage harvested for grain. The average annual acreage harvested for grain was less in 1950-54 than in 1935-39. However, in each year since 1954, the acreage harvested, although less than the 1935-39 average, has exceeded the 1950-54 average (Table 3). Acreage has declined in all Crop Reporting Districts except Districts 1 and 4, both of which have reported significant increases.

The acreage harvested for corn has decreased while acreages of small grains have increased (Table 4). The average annual acreage harvested for corn was less in 1950-54 than in 1935-39 while acreages of small grains were larger. Corn acreage has declined successively in each year since 1954. Acreages of small grains have exceeded the 1950-54 average in each year since 1954.

Yields

Larger production of grain on less acreage has been due to improved practices that have brought large increases in yields per acre of corn and soybeans (Table 5). Better seed, heavier fertilization, supplemental irrigation, use of better land, and improved cultural practices all have contributed to the increase. Improved production methods have not been adopted uniformly, however, and changes in yields have varied widely among the Crop Reporting Districts (Appendix tables 7-9).

---

[1] For purposes of this study grains include corn, oats, soybeans, wheat, barley and grain sorghum.

Table 1. Corn, oats and soybeans: Production by crop reporting districts, Mississippi, selected periods.

District	1935-39 Average*	1950-54 Average	1955	1956	1957	1958	1959
			Thousand bushels				
1	6,158	5,872	10,721	9,997	9,567	9,861	12,641
2	4,331	5,153	7,800	5,888	5,237	7,687	7,330
3	3,910	5,147	6,851	6,622	5,556	7,827	7,365
4	8,682	9,188	14,826	17,093	15,026	13,471	17,030
5	5,836	5,642	9,070	6,701	6,833	6,997	7,412
6	4,468	4,900	6,607	5,301	5,595	5,846	5,365
7	4,005	3,356	4,730	3,915	3,984	4,043	4,197
8	4,345	4,616	5,726	5,117	4,854	5,671	5,240
9	4,341	4,657	6,013	5,573	5,225	5,856	5,290
State**	46,076	49,066	73,758	67,585	67,100	70,900	73,565

Source: Appendix tables 1-3 and Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

*Production by crop reporting districts estimated as follows: Production for each district in 1935 and 1939 averaged and expressed as a percent of average state production in 1935 and 1939. These percentages applied to state average production for 5-year period, 1935-39.

**Grain sorghum, wheat and barley not available by districts. Appear only in state totals.

Table 2. Production: Specified grains, Mississippi, selected periods, with comparisons.

Grain	1935-39 Average	1950-54 Average	1955	1956	1957	1958	1959	1959 as percent of 1935-39 ave.
				Thousand bushels				
Corn	43,234	35,969	48,420	39,150	37,575	44,469	42,501	98
Oats	2,581	6,800	12,030	15,345	12,617	4,390	8,600	333
Soybeans	261	5,762	11,894	11,712	11,685	18,400	20,769	—
Wheat	*	535	286	504	3,483	1,904	858	—
Barley	*	*	748	640	450	57	155	—
Sorghum	*	*	380	234	1,290	1,680	682	—
Total	46,076	49,066	73,758	67,585	67,100	70,900	73,565	160

Source: Appendix tables 1-3 and Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

* Not reported.

Table 3. Corn, oats and soybeans: Acreage harvested, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Average*	1950-54 Average	1955	1956	1957	1958	1959
				Thousand acres			
1	309	286	405	418	358	389	463
2	316	264	264	267	248	254	240
3	265	247	245	256	249	254	249
4	424	434	599	612	551	510	572
5	421	290	299	291	284	258	258
6	355	266	246	247	236	224	211
7	308	165	157	147	146	135	125
8	332	221	212	196	185	178	174
9	317	221	215	208	204	191	182
State**	3,047	2,414	2,709	2,693	2,684	2,564	2,534

Source: Appendix tables 4-6 and Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

*See Footnote 1, Table 1.

**Grain sorghum, wheat and barley not available by districts. Appear only in state totals.

Table 4. Acreage harvested for grain: Specified grains, Mississippi, selected periods, with comparisons.

Grain	1935-39 Average	1950-54 Average	1955	1956	1957	1958	1959	1959 as percent of 1935-39 ave.
				Thousand acres				
Corn	2,931	1,806	1,614	1,568	1,503	1,458	1,371	47
Oats	86	187	402	341	341	134	200	233
Soybeans	30	401	626	733	617	801	903	—
Wheat	*	20	13	18	162	112	33	—
Barley	*	*	34	20	18	3	5	—
Sorghum	*	*	20	13	43	56	22	—
Total	3,047	2,414	2,709	2,693	2,684	2,564	2,534	83

Source: Appendix tables 4-6 and Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

* Not reported.

Table 5. Yields per acre: Specified grains, Mississippi, selected periods with comparisons.

Grain	1935-39 Average	1950-54 Average	1955	1956	1957	1958	1959	1959 as percent of 1935-39 ave.
				Bushels per acre				
Corn	14.8	19.9	30.0	25.0	25.0	30.5	31.0	209
Oats	30.0	36.4	29.9	45.0	37.0	32.8	43.0	143
Soybeans	11.5	14.4	19.0	16.0	18.9	23.0	23.0	200
Wheat	*	26.8	22.0	28.0	21.5	17.0	26.0	—
Barley	*	*	22.0	32.0	25.0	19.0	31.0	—
Sorghum	*	*	19.0	18.0	30.0	30.0	31.0	—

Source: Appendix tables 7-9 and Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

* Not reported.

CHANGING UTILIZATION OF GRAIN

The grain marketing problems created by the increased production of grain have been made more acute by the marked increase in the proportion of grain production that has entered marketing channels. This increase has resulted from rapid declines in numbers of horses and mules and from changes in the extent of specialization in agriculture. The quantity of grain produced for cash sale has increased and production of grain-consuming livestock has been concentrated to a greater extent in specilized units where the grain fed has been purchased rather than produced.

Changes In The Disposition of Grain

The magnitude of the adjustments that have been necessary in the grain marketing system is shown clearly by changes in the amount of grain that has entered marketing channels (Table 6). In each year since 1954, the quantity of grain that has entered marketing channels has been more than 11 times the 1935-39 average and more than twice the 1950-54 average.

Less than 20 percent of the grain produced in 1935-39 entered marketing channels; over 40 percent has entered marketing channels in recent years (Table 7). While the proportion of production that has entered marketing channels in recent years has been less for corn than for any other grain, the volume of corn marketed has been exceeded only by that of soybeans.

Changes in Livestock Numbers

Increases in the production and marketing of grain have been accompanied by increases in livestock numbers. Declines in numbers of some classes of livestock have been more than offset by increases in numbers of other classes as shown by inventories as of January 1 of each year (Appendix tables 10-14). The number of animal units of grain-consuming livestock fed annually is a better measure of feed grain requirements than is the January 1 inventory of livestock numbers. The number of animal units of grain-consuming livestock fed annually has increased in each year since 1954 and, in 1959, exceeded the 1935-39 average by 12 percent (Table 8). The greatest increase was in commercial broilers (Table 9).

Changes in Consumption of Concentrate Feeds[2]

The quantity of concentrates fed to livestock increased from an average of 1.6 million tons in 1935-39 to more than 2.3 million tons in 1959 (Table 8). Also, consumption in each recent year has exceeded that of the previous year. Grain has been a significant part of the increase in the consumption of concentrates.

The increase in commercial broiler production has been a major factor in the expanding consumption of concentrate feeds (Table 9). Consumption of concentrates by broilers increased from an average of 12.7 thousand tons in 1950-54 to almost 400 thousand tons in 1959. The quantity of grain in broiler feeds increased from 7.6 thousand tons to almost 252 thousand tons during the same period.

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[2] Concentrate feeds include grains, high-protein feeds, mill feeds, other by-product feeds and formula feeds.

Table 6. Quantities of grain entering marketing channels, Mississippi, selected grains and selected periods.

Grain	1935-39 Average	1950-54 Average	1955	1956	1957	1958	1959
			Thousand bushels				
Corn	2,192	4,295	11,275	6,024	7,970	8,171	9,454
Oats	118	2,948	4,812	9,974	7,823	1,097	4,730
Soybeans	86	5,308	11,306	11,121	10,945	17,634	20,049
Wheat	*	375	113	347	3,279	1,633	655
Barley	*	*	209	224	135	11	46
Five grains	2,396	12,926	27,715	27,690	30,152	28,546	34,934

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

* Not reported.

Table 7. Grain entering marketing channels as percent of production, Mississippi, selected grains and selected periods.

Grain	1935-39 Average	1950-54 Average	1955	1956	1957	1958	1959
			Percent				
Corn	5.0	11.9	23.3	15.4	21.2	18.4	22.2
Oats	4.7	43.4	40.0	65.0	62.0	25.0	55.0
Soybeans	34.0	92.1	95.1	95.0	93.7	95.8	96.5
Wheat	*	70.1	39.5	68.8	94.1	85.8	76.3
Barley	*	*	28.0	35.0	30.0	19.3	29.7
Five grains	17.4	26.3	37.8	41.1	45.8	41.2	47.5

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

* Not reported.

Table 8. Animal units of grain-consuming livestock fed and total concentrates fed, Mississippi, selected periods with comparisons.

Item	Year beginning October 1							1959 as percent of 1935-39 avg.
	1935-39 Average	1950-54 Average	1955	1956	1957	1958	1959	
Animal units* (Thousands)	2,471	2,379	2,472	2,530	2,613	2,655	2,773	112
Concentrates fed** (Thousand tons)	1,606	1,865	1,978	2,049	2,247	2,283	2,385	149

*United States Department of Agriculture Statistical Bulletins No. 194 and 255.

**Estimated by multiplying number of animal units by estimates of tons of concentrates fed per animal unit in the United States (estimates of concentrates fed per grain-consuming animal unit were taken from Table 9 of USDA Statistical Bulletin No. 255).

Table 9. Pounds of broilers produced, concentrates fed to broilers and feed grain fed to broilers, Mississippi, selected periods.

Item	1950-54 Average	1955	1956	1957	1958	1959
Broilers produced (Thousand pounds)	81,726	104,961	153,280	206,451	264,814	333,154
Concentrates fed to broilers* (Thousand tons)	12.7	152.1	214.6	278.7	331.0	399.8
Feed grain fed to broilers** (Thousand tons)	7.6	91.3	139.5	183.9	215.2	251.9

Source: Production data from Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Estimates of concentrate consumption and of the proportion of the ration that was grain provided by Poultry Department, Mississippi Agricultural Experiment Station.

*Computed by multiplying pounds of broilers produced by the estimated pounds of concentrates fed per pound of broiler produced (3.1 pounds for 1950-54; 2.9 pounds for 1955; 2.8 pounds for 1956; 2.7 pounds for 1957; 2.5 pounds for 1958; 2.4 pounds for 1959) and dividing the product by 2,000.

**Computed by multiplying concentrates fed by estimates of the proportion of the ration that was grain (60 percent for 1950-54 and 1955; 65 percent for 1956; 66 percent for 1957; 65 percent for 1958; 63 percent for 1959).

THE GRAIN STORAGE SITUATION

Increases in grain production, movement of a larger proportion of production through marketing channels, feeding of larger quantities of grain by specialized livestock producers and greater participation in Commodity Credit Corporation programs have increased the need for grain storage facilities in the state. The quantity of storage available has increased in recent years but further increases are necessary for more efficient marketing of grain.

Observation indicates that some kind of storage is always available for all of the grain that is harvested. However, much of the storage that is available is of such poor quality that grain stored in it either is lost or reduced in value by damage from weather, rodents and insects.[3] Frequently, facilities are not available for drying grain and for controlling moisture while grain is in storage. Severe losses from moisture damage of stored grain are the result.

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[3] For estimates by farmers of damage to farm stored grain from specified causes see Appendix table 25. For age of on-farm storage facilities see Appendix table 26.

Grain Storage Capacity

The total capacity of grain elevators and on-farm storage facilities in Mississippi as of mid-year 1958 was estimated to be 83.6 million bushels (Table 10). Farm storage facilities, which accounted for almost 90 percent of the total, consisted of 55.9 million bushels of ear corn storage and 15.8 million bushels of small grain storage. Over 12 percent of the elevator storage was connected with feed mills; the remainder was classified as commercial storage.

The storage capacity reported as being available to farmers totaled almost 80 million bushels; 73.8 million bushels of on-farm storage plus 6 million bushels of the elevator storage (Table 11). All of the 1.2 million bushels of storage at feed mills and 2.6 million bushels of the commercial elevator capacity was reported as not being available to farmers.

Not all of the elevator storage capacity in the state was suitable for long-time storage. Only 820,000 bushels of the capacity at feed mills and 6.9 million bushels of the commercial elevator capacity were equipped with facilities for drying and aerating grain (Table 12). The remaining 2.1 million bushels of elevator capacity served farmers as only limited market outlets for high-moisture grain. Of the 6 million bushels of elevator storage available to farmers, only 5.3 million bushels were equipped with drying and aerating equipment (Table 12).

The quality of on-farm storage facilities, particularly ear corn facilities, was generally poor. On-farm storage facilities cannot be considered adequate for long-time storage unless they are weather proof, ventilated, suitable for fumigation and rodent proof. Only 15 million bushels, 11.6 and 3.4 million bushels, respectively, of small grain

Table 10. Grain storage capacity by kind of storage, Mississippi, by crop reporting districts, June, 1958.

District	Total storage capacity	Elevator Storage Capacity			Farm Storage Capacity			
		Commercial	Feed mill	Total	Ear corn	Small grains	Miscellaneous*	Total
	Thousand bushels							
1	10,482	2,042	100	2,142	3,900	4,410	30	8,340
2	7,190	12	18	30	6,300	580	280	7,160
3	8,909	26	293	319	7,700	300	590	8,590
4	17,100	5,634	196	5,830	3,800	7,360	110	11,270
5	9,506	212	109	321	8,100	700	385	9,185
6	8,602	65	27	92	7,200	1,030	280	8,510
7	6,886	600	471	1,071	5,200	600	15	5,815
8	6,700	—	—	—	6,300	320	80	6,700
9	8,277	40	27	67	7,400	500	310	8,210
State	83,652	8,631	1,241	9,872	55,900	15,800	2,080	73,780

Source: Elevator storage capacity determined by enumeration of all known elevator facilities; farm storage capacity taken from Appendix tables 18-20.

*Such structures as tenant houses, sheds, etc.

Table 11. Grain storage capacity by kind of storage and availability to farmers and CCC, by crop reporting districts, Mississippi, June, 1958.

District	Total Storage Capacity		Elevator Storage Capacity		Farm Storage Capacity	
	Available to farmers	Approved for CCC storage	Total	Available to farmers and approved for CCC storage	Total	Approved for CCC storage
	Thousand bushels					
1	9,796	5,543	2,142	1,456	8,340	4,087
2	7,160	565	30	—	7,160	565
3	8,616	431	319	26	8,590	405
4	15,541	9,906	5,830	4,271	11,270	5,635
5	9,385	659	321	200	9,185	459
6	8,575	550	92	65	8,510	485
7	5,815	75	1,071	—	5,815	75
8	6,700	20	—	—	6,700	20
9	8,210	280	67	—	8,210	280
State	79,798	18,029	9,872	6,018	73,780	12,011

Source: Elevator storage capacity determined by renumeration of all known elevator facilities; farm storage capacity taken from Appendix table 24.

Table 12. Capacity of elevator storage with drying and aeration facilities, by kind of storage and availability to farmers and CCC, by crop reporting districts, Mississippi, June, 1958.

District	Capacity of elevator storage with drying and aeration facilities			
	Total	Commercial	Feed Mill	Available to farmers and approved for CCC storage
	Thousand bushels			
1	1,296	1,196	100	849
2	—	—	—	—
3	276	26	250	26
4	5,579	5,399	180	4,199
5	240	200	40	200
6	65	65	—	65
7	250	—	250	—
8	—	—	—	—
9	40	40	—	—
State	7,746	6,926	820	5,339

Source: Enumeration of all known elevator facilities.

and ear corn facilities, of the on-farm storage in the state was reported as being rodent proof (Table 13). This was the only storage that could have possessed all of the characteristics necessary for long-time storage. Consequently, 15 million bushels can be considered the maximum amount of on-farm storage capacity available for long-time storage.

Thus, only 20.3 million bushels of the total grain storage capacity of 83.6 million bushels was available to farmers for long-time storage. Furthermore, the 15 million bushels of on-farm storage suitable for long-time storage was not completely effective because on-farm facilities for handling high-moisture grain were severely limited.[4]

Only 18 million bushels of storage (6 million elevator and 12 million on-farm) was approved for Commodity Credit Corporation storage and / or handling. Most of this capacity was in Crop Reporting Districts 1 and 4 (Table 11). In the remaining districts, approved storage capacity was so small that participation in the price support program was necessarily limited.

The Grain Storage Deficit[5]

The capacity of grain storage facilities available to farmers and suitable for long-time storage is significantly less than storable supplies. The situation is most critical for small grains in the fall harvest period. In the fall of 1958, for example, the carry-over of oats plus the production of soybeans and grain sorghum exceeded the capacity of adequate[6] small grain storage available to farmers by 7.2 million bushels (Table 14). The situation was worse in 1959 even if farmers added the facilities they stated they expected to add in 1958. With the added storage, the capacity of adequate small grain storage in 1959 totaled 17.8 million bushels; storable supplies totaled 26.2 million bushels.

The storage requirement for ear corn exceeded the capacity of adequate storage by 42.5 million bushels in 1958. If farmers added the ear corn storage facilities they stated they expected to add in 1958, the deficit was reduced to 39.1 million bushels in 1959. Storage capacity would have been 2.6 million bushels greater; storable supplies, .8 million bushels less. Despite the larger absolute deficit for ear corn, the situation was not as critical as for small grains. Ear corn can be handled in sub-standard storage much more easily than can small grains.

The capacity of small grain storage available to farmers and suitable for

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[4] Although some farm drying and aerating facilities were known to exist, they were so few in number that none of the farms included in the large sample surveyed reported any such facilities.

[5] The deficit is summarized for the state. The extent of the deficit varies widely among crop reporting districts. The deficit for any crop reporting district can be computed from the detailed data contained in the Appendix tables.

[6] Adequate as used here and in other parts of this report means suitable for long-time storage.

Table 13. On-farm grain storage capacity by specified characteristics, Mississippi, by crop reporting districts, June, 1958.

District	Ear Corn				Small Grains				Total*			
	Weather proof	Rodent proof	Can be fumigated	Ventilated	Weather proof	Rodent proof	Can be fumigated	Ventilated	Weather proof	Rodent proof	Can be fumigated	Ventilated
	Thousand bushels											
1	2,683	320	2,075	1,911	4,399	3,603	4,326	4,263	7,112	3,923	6,401	6,190
2	5,978	354	1,120	3,710	580	552	562	580	6,838	906	1,682	4,290
3	6,198	285	1,286	3,419	300	96	300	300	7,088	381	1,586	3,719
4	3,422	97	2,529	2,529	7,249	6,104	7,249	7,249	10,781	6,201	9,815	9,778
5	6,734	407	2,978	4,114	700	220	450	450	7,794	627	3,428	4,589
6	7,092	806	2,621	4,522	1,030	383	621	455	8,402	1,189	3,270	5,005
7	4,716	26	848	4,633	600	476	595	598	5,331	502	1,443	5,231
8	5,191	214	1,027	2,381	320	50	163	248	5,574	270	1,196	2,635
9	7,156	936	2,819	4,710	500	91	486	500	7,966	1,027	3,305	5,324
State	49,170	3,445	17,303	31,929	15,678	11,575	14,752	14,643	66,886	15,026	32,126	46,761

Source: Appendix tables 21-23.
*Totals include capacity of miscellaneous structures used for storage.

Table 14. Grains: Selected information about stocks, production, storable supplies and storage facilities in Mississippi.

Year	Stocks in all positions on April 1			Production of spring-harvested grains	Storable supplies			Capacity of grain storage facilities					
								All facilities			Available to farmers & suitable for long-time storage		
	Corn	Oats	Corn & oats		Ear corn	Small grains	Total	Ear corn	Small grains	Total	Ear corn	Small grains	Total
	Thousand bushels												
1956	17,905	4,164	22,069	16,489	17,905	20,653	38,558						
1957	13,162	2,959	16,121	16,550	13,162	19,509	32,671						
1958	10,932	3,070	14,002	6,351	10,932	9,421	20,353	57,980**	25,672	83,652	3,445	16,914	20,359
1959*	15,342	928	16,270	9,613	15,342	10,541	25,883	60,380	26,572	86,952	6,045	17,814	23,859
1956-59 Av.	14,335	2,780	17,115	12,251	14,335	15,031	29,366						

Year	Stocks in all positions on October 1			Production of fall-harvested grains		Storable supplies			Capacity of grain storage facilities					
									All facilities			Available to farmers & suitable for long-time storage		
	Corn	Oats	Corn & oats	Corn	Small grains	Ear corn	Small grains	Total	Ear corn	Small grains	Total	Ear corn	Small grains	Total
	Thousand bushels													
1956	3,338	8,892	12,230	39,150	11,946	42,488	20,838	63,326						
1957	2,142	7,315	9,457	37,575	12,975	39,717	20,290	60,007						
1958	1,483	4,046	5,529	44,469	20,080	45,952	24,126	70,078	57,980**	25,672	83,652	3,445	16,914	20,359
1959*	2,653	4,716	7,369	42,501	21,451	45,154	26,167	71,321	60,380	26,572	86,952	6,045	17,814	23,859
1956-59 Average	2,404	6,242	8,646	40,923	16,613	43,328	22,855	66,183						

Source: Stocks of grain taken from selected issues of **Stocks of Grain in All Positions**, AMS, USDA; Production taken from Table 2; Total ear corn storage computed from Appendix Tables 18 and 20 and total small grain storage computed from Table 10 and Appendix Table 19; storage available to farmers and suitable for long-time storage computed from Tables 12 and 13.
*Storage capacity for 1959 is June, 1958 capacity plus storage farmers stated they expected to add in 1958. (See Appendix Table 27).
**Includes the 2,080,000 bushels of miscellaneous storage. (Table 10).

long-time storage exceeded storable supplies in the springs of 1958 and 1959. However, if the oat crops of 1958 and 1959 had been as large as in the two previous years storage would have been deficit (Table 14). The relationship of post-harvest prices to support prices for oats (Table 15) for the crops of 1956 through 1959 support this conclusion.

ECONOMIC CONSIDERATIONS IN GRAIN STORAGE

The primary determinants of the economic feasibility of storing grains are support prices, prices at harvest, expected seasonal price increases and cost of storing.

In each of the past few years support prices of one or more of the grains have exceeded post-harvest prices in Mississippi (Table 15) by more than the cost incurred in qualifying for price supports. To qualify for price support grain must be in approved storage. The costs of qualifying are receiving charges at elevators (Table 16) if commercial storage is used and actual cost of storage if farm storage is used. Grain can be stored on farms in metal storage bins for as little as 6 cents per bushel.[7]

The seasonal increases in prices of soybeans, corn and oats normally exceed the cost of receiving and storing in commercial elevators (Tables 16 and 17). During the period 1949-58, prices six months after harvest averaged 40 cents higher for soy beans, 19 cents higher for corn and 12 cents higher for oats. However, there may be a slight downward trend in these price spreads. Until recently costs of receiving and storing for six months have been 16 cents for soybeans, 11.8 cents for corn and 8.5 cents for oats.[8] For each of these grains, the six-month increase in price was greater than the cost of receiving and storage in seven of the ten years.

Where commercial storage facilities are not available, storage can be done only on the farm. Storing on the farm without provisions for drying is excessively hazardous. While on-farm drying adds to the cost of storage it usually increases returns from storage by more than drying costs. Provision of facilities for drying permits earlier harvesting of grain of higher moisture content. Earlier harvesting reduces both shatter loss and quality deterioration. Two advantages of drying early-harvested grain are: (1) It makes it possible to avoid commercial moisture

Table 15. Support prices and post-harvest prices, with differences, selected grains, Mississippi, 1956-1959.

Year and Price	Corn	Soybeans	Oats
		Dollars per bushel	
1956—			
Support*	1.36	2.13	.78
Post-harvest**	1.17	2.13	.70
Difference	—.19	.00	—.08
1957—			
Support	1.40	2.06	.72
Post-harvest	1.19	2.01	.67
Difference	—.21	—.05	—.05
1958—			
Support	1.12	2.06	.70
Post-harvest	1.12	1.88	.74
Difference	.00	—.18	.04
1959—			
Support	1.17	1.82	.59
Post-harvest	1.08	1.95	.72
Difference	—.09	.13	.13

Source: Appendix Tables 15 and 16.

*Post-harvest price is the average of prices received in October-December for corn and soybeans and the average of prices received in June-August for oats

**Negative differences mean that support price exceeded post-harvest price.

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[7] See Mississippi Agricultural Experiment Station Bulletin 594 for costs of drying and storing grains on farms.

[8] Revised rates for receiving and storage become effective on July 1, 1960 (see Table 16).

discounts, which frequently exceed drying costs and (2) it makes it possible to sell grain before the harvest price-break.

On-farm drying and storage facilities require little initial capital outlay on the part of the farmer. "To encourage increased farm storage capacity, CCC makes loans to farmers to finance new farm storage facilities for grains and other storable crops. Such loans, which may be for up to 80 percent of the cost of the structure, are payable in four annual installments, at an interest rate of 4 percent a year. xxx

"In November 1949, CCC began making loans on farm storage equipment, such as driers, air circulators, and ventilators. xxx

"Farmers arrange for farm storage facility and equipment loans with their Agricultural Stabilization and Conservation County Committees. xxx

"Also of assistance in expanding farm storage facilities are the reseal programs through which farmers may continue their price support loans on certain commodities for specified periods and receive storage payments. xxx

"Storage rates per reseal year are: Corn and barley, 16 cents per bushel; oats, 12 cents per bushel; wheat, rye and soybeans, 16 or 17 cents per bushel, depending on the area; ——; and grain sorghum 28-31 cents per hundredweight, depending on the area."[9]

On May 5, 1960, the USDA announced that reseal rates for 1960-61 would be reduced by 2 cents for all grains except grain sorghum for which a 4 cent reduction would become effective.

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[9] U. S. Department of Agriculture, Commodity Stabilization Service, CSS Background Information, BI No. 8, November 1959, pp. 3-4.

Table 16. Charges for receiving and storage, selected grains, Mississippi, selected periods.

Period and Commodity	Receiving charge*	Storage charge		Receiving and storage for 180 days
		Per day	For 180 days	
	Cents per bushel	Thousandths of cents per bushel	Cents per bushel	Cents per bushel
1956-1959—				
Soybeans	7.25	49	8.8	16.05
Corn	3.75	45	8.1	11.85
Oats	2.75	32	5.8	8.55
From July 1, 1960**				
Soybeans	5.00	37	6.7	11.70
Corn	4.25	37	6.7	10.95
Oats	2.75	28	5.0	7.75

Source: Commodity Credit Corporation Form 25-1 (4-16-56) and Press Release, USDA 1315-60, May 5, 1960.

*For truck receipts. Charges are less for receipts by rail or water.

**New rates announced May 5, 1960.

Table 17. Soybeans, corn and oats: Average prices in the harvest quarter and six months later, with differences, Mississippi, 1949-1958.

Year*	Soybeans			Corn			Oats		
	Harvest quarter (Oct-Nov-Dec)	Six months later (Apr-May-Jun)	Difference	Harvest quarter (Oct-Nov-Dec)	Six months later (Apr-May Jun)	Difference	Harvest quarter (Jun-Jul-Aug)	Six months later (Dec-Jan-Feb)	Difference
				Dollars per bushel					
1949	2.01	2.55	.54	1.16	1.50	.34	.85	.90	.05
1950	2.22	3.03	.81	1.30	1.57	.27	.98	1.11	.13
1951	2.60	2.85	.25	1.62	1.99	.37	1.00	1.18	.18
1952	2.72	2.87	.15	1.91	1.91	.00	1.01	1.14	.13
1953	2.50	3.27	.77	1.53	1.63	.10	.82	.95	.13
1954	2.47	2.57	.10	1.54	1.57	.03	.75	.95	.20
1955	1.95	2.68	.73	1.00	1.16	.16	.71	.77	.06
1956	2.13	2.28	.15	1.17	1.33	.16	.70	.85	.15
1957	2.01	2.18	.17	1.19	1.41	.22	.67	.76	.09
1958	1.88	2.22	.34	1.12	1.30	.18	.74	.78	.04
1949-58 Av.	2.25	2.65	.40	1.35	1.54	.19	.82	.94	.12

Source: Appendix Table 15.

*Year beginning October for soybeans and corn; June for oats.

APPENDIX TABLES

Table 1. Corn: Production, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand bushels				
1	5,356	2,558	3,645	2,527	2,802	2,180	2,325
2	4,319	4,447	6,726	4,823	4,152	6,497	6,092
3	3,887	4,864	6,368	6,049	4,865	6,893	6,521
4	6,954	3,016	3,671	3,274	2,728	3,153	3,225
5	5,658	4,850	7,389	4,971	5,386	5,871	5,957
6	4,449	4,393	5,618	4,328	4,768	5,230	4,609
7	3,974	3,050	4,126	3,322	3,460	3,658	3,766
8	4,319	4,337	5,275	4,636	4,505	5,409	4,984
9	4,318	4,454	5,602	5,220	4,909	5,578	5,022
State	43,234	35,969	48,420	39,150	37,575	44,469	42,501

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 2. Oats: Production, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand bushels				
1	728	1,274	2,422	3,157	2,625	807	1,442
2	—	406	550	415	445	158	258
3	—	93	177	119	121	59	63
4	1,648	3,372	5,611	8,527	7,009	2,131	5,114
5	161	481	1,104	1,116	893	372	623
6	5	455	877	823	615	311	452
7	13	260	515	478	383	194	271
8	18	279	433	458	322	229	229
9	8	180	341	252	204	129	147
State	2,581	6,800	12,030	15,345	12,617	4,390	8,600

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 3. Soybeans: Production, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand bushels				
1	74	2,040	4,654	4,313	4,140	6,874	8,874
2	12	300	524	650	640	1,032	980
3	23	190	306	454	570	875	781
4	80	2,800	5,544	5,292	5,289	8,187	8,691
5	17	311	577	614	554	754	832
6	14	52	112	150	212	305	304
7	18	46	89	115	141	191	160
8	8	—	18	23	27	33	27
9	15	23	70	101	112	149	119
State	261	5,762	11,894	11,712	11,685	18,400	20,769

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 4. Corn: Acreage harvested, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand acres				
1	275	116	98	85	81	65	60
2	314	236	219	215	200	203	185
3	264	233	223	225	214	212	204
4	363	140	101	107	92	97	90
5	413	255	235	225	227	214	205
6	352	248	210	212	201	198	183
7	305	153	135	126	125	120	108
8	331	212	195	180	172	169	166
9	314	213	198	193	191	180	170
State	2,931	1,806	1,614	1,568	1,503	1,458	1,371

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 5. Oats: Acreage harvested, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand acres				
1	22	33	82	63	68	24	33
2	1	10	16	13	11	5	7
3	—	3	6	4	4	2	2
4	49	88	190	170	180	62	109
5	7	15	32	29	25	11	15
6	2	14	30	25	23	12	13
7	2	9	17	14	13	7	9
8	1	9	16	14	11	7	7
9	2	6	13	9	6	4	5
State	86	187	402	341	341	134	200

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 6. Soybeans: Acreage harvested, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand acres				
1	12	137	225	270	209	300	370
2	1	18	29	39	37	46	48
3	1	11	16	27	31	40	43
4	12	206	308	335	279	351	373
5	1	20	32	37	32	33	38
6	1	4	6	10	12	14	15
7	1	3	5	7	8	8	8
8	—	-	1	2	2	2	1
9	1	2	4	6	7	7	7
State	30	401	626	733	617	801	903

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 7. Corn: Yield, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Bushels per acre				
1	19.7	22.0	37.2	29.7	34.6	33.5	38.8
2	13.7	18.8	30.7	22.4	20.8	32.0	32.9
3	14.8	20.9	28.6	26.8	22.7	32.5	32.0
4	19.2	21.5	30.7	36.3	29.7	32.5	35.8
5	13.7	19.0	31.4	22.1	23.7	27.4	29.1
6	12.7	17.7	26.8	20.5	23.7	26.4	25.2
7	13.1	20.0	30.6	26.5	27.7	30.5	34.9
8	13.1	20.5	27.0	25.8	26.2	32.0	30.0
9	13.8	21.0	28.3	27.1	25.7	31.0	29.5
State	14.8	19.9	30.0	25.0	25.0	30.5	31.0

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 8. Oats: Yield, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Bushels per acre				
1	33.1	38.6	29.5	50.0	38.6	33.9	43.7
2	—	38.3	33.7	31.9	40.4	31.5	38.0
3	—	33.9	30.6	29.6	30.2	27.0	31.5
4	33.6	38.3	29.5	50.2	38.9	34.4	46.8
5	23.0	31.3	34.8	38.5	35.7	33.8	41.5
6	—	32.4	29.5	32.9	26.7	27.0	34.8
7	—	29.8	30.6	34.2	29.4	28.1	31.1
8	—	29.4	27.4	32.7	29.3	34.7	31.0
9	—	31.0	26.4	28.3	33.9	32.2	31.2
State	30.0	36.4	29.9	45.0	37.0	32.8	43.0

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 9. Soybeans: Yield, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Bushels per acre				
1	16.2	15.3	20.7	16.0	19.8	22.9	24.0
2	—	16.6	18.1	16.8	17.5	22.4	20.4
3	—	18.0	19.1	16.8	18.5	21.9	18.4
4	15.0	13.9	18.0	15.8	19.0	23.3	23.3
5	—	15.6	18.0	16.5	17.5	22.8	21.9
6	—	14.7	18.7	15.5	18.2	22.6	20.3
7	—	16.8	17.8	17.2	17.4	23.9	20.0
8	—	—	18.0	15.0	16.6	22.0	18.0
9	—	11.7	17.5	16.0	16.6	21.3	17.0
State	11.5	14.4	19.0	16.0	18.9	23.0	23.0

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 10. Livestock: Numbers on farms January 1, by selected class of livestock, Mississippi, selected periods.

Item	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand head				
All cattle and calves	1,303	1,820	2,370	2,440	2,539	2,487	2,363
Milk cows	558	569	587	593	579	558	519
Hogs and pigs	1,028	829	631	808	840	764	741
Horses and mules	440	332	302	242	218	198	170
Sheep	72	78	91	97	105	110	100
Broilers*	220	29,442	37,486	52,855	66,597	85,424	107,469
Hens and pullets and other chickens	7,464	6,739	5,767	5,608	5,483	5,212	5,367

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

*Number produced annually.

Table 11. Cattle and Calves: Number on farms January 1, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand head				
1	47	66	94	98	103	101	89
2	158	222	260	264	276	269	257
3	112	133	157	160	164	161	154
4	83	123	192	201	209	205	186
5	195	259	341	351	364	355	333
6	199	262	327	336	347	343	328
7	225	308	391	401	422	414	396
8	107	197	267	276	285	278	269
9	177	250	341	353	369	361	351
State	1,303	1,820	2,370	2,440	2,539	2,487	2,363

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 12. Cows and heifers two-years-old and over: Number on farms January 1, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand head				
1	26	39	53	55	57	57	52
2	87	138	164	164	171	169	164
3	67	79	92	93	95	94	93
4	43	73	110	114	117	117	108
5	102	151	203	207	213	211	203
6	118	157	195	198	204	204	198
7	120	186	235	238	249	248	242
8	55	114	156	160	164	162	161
9	91	149	199	204	212	211	210
State	709	1,086	1,407	1,433	1,482	1,473	1,431

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 13. Milk cows: Number on farms January 1, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand head				
1	25	18	17	16	15	14	12
2	77	75	70	69	67	65	61
3	69	69	74	76	74	71	68
4	35	25	25	24	22	21	18
5	82	76	78	79	76	73	68
6	107	105	109	110	108	105	93
7	63	64	63	64	63	61	55
8	43	65	72	74	74	72	71
9	57	72	79	81	80	76	73
State	558	569	587	593	579	558	519

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 14. Hogs and pigs: Number on farms January 1, by crop reporting districts, Mississippi, selected periods.

District	1935-39 Av.	1950-54 Av.	1955	1956	1957	1958	1959
			Thousand head				
1	117	81	53	65	71	64	57
2	115	102	77	100	102	90	89
3	66	73	62	82	82	78	77
4	159	104	71	93	98	83	84
5	124	102	82	102	111	101	96
6	109	85	63	80	81	76	71
7	118	93	70	94	96	89	85
8	89	66	51	65	69	64	61
9	131	125	102	127	130	120	122
State	1,028	831	631	808	840	764	741

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi.

Table 15. Soybeans, corn and oats: Monthly and annual average prices received by farmers, Mississippi, selected periods.

Grain and year*	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Annual Average
Soybeans:					Dollars per bushel								
1949	2.00	1.94	2.10	2.20	2.35	2.35	2.50	2.70	2.45	2.50	2.35	2,25	2.31
1950	1.95	2.30	2.40	2.70	2.95	3.05	3.00	3.10	3 00	2.80	2.60	2,50	2.70
1951	2.40	2.70	2.70	2.75	2.75	2.75	2.85	2.75	2 95	2.85	2.90	2.75	2.76
1952	2.75	2.70	2.70	2.65	2.70	2.80	2.90	2.90	2 80	2.65	2.50	2.30	2.70
1953	2.40	2.50	2.60	2.70	2.85	3.10	3.35	3.35	3 10	2.85	2.70	2.60	2.84
1954	2.35	2.50	2.55	2.60	2.75	2.70	2.60	2.60	2 50	2.40	2.05	2.00	2.47
1955	2.00	1.90	1.95	2.05	2.15	2.35	2.45	2.85	2 75	2.55	2.25	2.15	2.28
1956	2.05	2.15	2.20	2.25	2.30	2.30	2.30	2.30	2 25	2.30	2.23	2.10	2.23
1957	2.00	2.00	2.02	2 01	2.08	2.10	2.15	2.20	2 20	2.15	2.10	2.05	2.09
1958	1.90	1.85	1.90	2.00	2.10	2.07	2.18	2.21	2 27	2.25	2.05	1.90	2.06
1949-58 Average	2.18	2,25	2.31	2.39	2.50	2.56	2.63	2.70	2.63	2.53	2.37	2.26	2.44
Corn:													
1949	1.18	1.17	1.13	1.16	1.20	1.26	1.41	1.52	1 58	1.73	1.73	1.67	1.39
1950	1.40	1.24	1.25	1 35	1.46	1.54	1.54	1.59	1 59	1.61	1.59	1.57	1.48
1951	1.54	1.63	1.68	1.81	1.87	1.89	1.97	1.99	2.01	1.96	2.01	1.97	1.86
1952	1.95	1.88	1.91	1.91	1.93	1.90	1.90	1.90	1 92	1.93	1.86	1.76	1.90
1953	1.59	1.48	1.52	1.59	1.60	1.60	1.62	1.64	1 63	1.59	1.58	1.58	1.58
1954	1.58	1.52	1.51	1.51	1.59	1.54	1.55	1.58	1 57	1.56	1.50	1.25	1.52
1955	1.09	.97	.94	1.00	1.01	1.05	1.13	1.14	1 20	1.22	1.26	1.23	1.10
1956	1.15	1.16	1.19	1.22	1.27	1.32	1.31	1.32	1 35	1.36	1.40	1.32	1.28
1957	1.23	1.14	1.20	1.23	1.29	1.32	1.38	1.42	1 42	1.41	1.45	1.26	1.31
1958	1.18	1.07	1.11	1.19	1.25	1.26	1.30	1.30	1 31	1.33	1.30	1.22	1.24
1949-58 Average	1.39	1.33	1.34	1.40	1.45	1.47	1.51	1.54	1 56	1.57	1.57	1.48	1.47
Oats:													
1949	.91	.87	.83	.86	.87	.94	1.00	.90	.90	.90	.90	1.01	.91
1950	1.03	.97	.98	.99	1.05	1.06	1.15	1.15	1 05	1.13	1.05	1.10	1.06
1951	1.04	1.04	.95	1.01	1.04	1.14	1.19	1.18	1 18	1.19	1.17	1.17	1.11
1952	1.19	1.00	.97	1.05	1.20	1 25	1.21	1.13	1.20	1.10	1.05	1.04	1.12
1953	.98	.80	.77	.89	.94	.98	.99	.95	.95	.94	.94	.94	.92
1954	.93	.71	.76	.78	.83	.85	.93	.95	.95	.95	.95	.85	.87
1955	.83	.73	.70	.71	.74	.74	.78	.78	.77	.77	.77	.76	.76
1956	.76	.68	.70	.73	.80	.83	.85	.85	.86	.84	.82	.78	.79
1957	.76	.61	.68	.72	.74	.76	.74	.76	.76	.76	.80	.76	.74
1958	.74	.71	.75	.76	.85	.82	.81	.76	.79	.80	.81	.81	.78
1949-58 Average	.92	.81	.81	.85	.91	.94	.96	.94	.94	.94	.93	.92	.91

Source: Selected volumes of **Crops and Markets** and selected issues of **Agricultural Prices.**
*Year beginning October 1 for soybeans and corn; May 1 for oats.

Table 16. Support prices* of selected grains, Mississippi, 1950-59

Year	Corn	Oats	Wheat	Soybeans
1950	1.24	.83	2.09	2.01
1951	1.73	.83	2.23	2.41
1952	1.76	.95	2.26	2.54
1953	1.76	.97	2.27	2.54
1954	1.34	.92	2.31	2.19
1955	1 30	.77	1.61	2.02
1956	1.36	.78	1.56	2.13
1957	1.40	.72	1.56	2.06
1958	1.12	.70	1.42	2.06
1959	1 17	.59	1.89	1.82

Source: United States Department of Agriculture, Commodity Stabilization Service, Washington, D. C.

*Basic support rates are for corn and oats grading No. 3, wheat grading No. 1, and green and yellow soybeans grading No. 2.

Table 17. Capacity of grain storage facilities on farms, by type of construction, by crop reporting districts, Mississippi, June, 1958.

District	Wood construction	Metal construction*	Total grain storage capacity
		Thousand bushels	
1	5,020	3,320	8,340
2	6,395	765	7,160
3	8,530	60	8,590
4	6,015	5,255	11,270
5	8,925	260	9,185
6	8,170	340	8,510
7	5,795	20	5,815
8	6,685	15	6,700
9	7,945	265	8,210
State	63,480	10,300	73,780

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

*Includes 50,000 bushels of concrete or brick construction.

Table 18. Capacity of ear corn storage facilities on farms, by type of construction, by crop reporting districts, Mississippi, June, 1958.

District	Wood construction	Metal construction*	Total ear corn storage capacity
		Thousand bushels	
1	3,900	—	3,900
2	6,080	220	6,300
3	7,700	—	7,700
4	3,600	200	3,800
5	7,940	160	8,100
6	7,200	—	7,200
7	5,200	—	5,200
8	6,300	—	6,300
9	7,180	220	7,400
State	55,100	800	55,900

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

*Includes 30,000 bushels of concrete or brick storage facilities.

Table 19. Capacity of small grain storage facilities on farms, by type of construction, by crop reporting districts, Mississippi, June, 1958.

District	Wood construction	Metal construction*	Total small grain storage capacity
		Thousand bushels	
1	1,090	3,320	4,410
2	35	545	580
3	240	60	300
4	2,305	5,055	7,360
5	600	100	700
6	690	340	1,030
7	580	20	600
8	305	15	320
9	455	45	500
State	6,300	9,500	15,800

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

*Includes 15,000 bushels of concrete or brick storage facilities.

Table 20. Capacity of miscellaneous grain storage facilities on farms, by crop reporting districts, Mississippi, June, 1958.

District	Capacity*	District	Capacity*
	Thousand bushels		Thousand bushels
1	30	6	280
2	280	7	15
3	590	8	80
4	110	9	310
5	385	State	2,080

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

*All storage facilities are of wood construction, except for 5,000 bushels of concrete or brick construction. Includes such structures as old tenant houses, sheds, barns, etc.

Table 21. On-farm storage facilities for ear corn: Capacity by specified characteristics, by crop reporting districts, Mississippi, June, 1958.

District	Wood-constructed					Metal-constructed				
	Total	Weather proof	Rodent proof	Fumigate	Ventilate	Total*	Weather proof	Rodent proof	Fumigate	Ventilate
					Thousand bushels					
1	3,900	2,683	320	2,075	1,911	—	—	—	—	—
2	6,080	5,758	334	900	3,490	220	220	20	220	220
3	7,700	6,198	285	1,286	3,419	—	—	—	—	—
4	3,600	3,222	83	2,329	2,329	200	200	14	200	200
5	7,940	6,574	397	2,898	3,954	160	160	10	80	160
6	7,200	7,092	806	2,621	4,522	—	—	—	—	—
7	5,200	4,716	26	848	4,633	—	—	—	—	—
8	6,300	5,191	214	1,027	2,381	—	—	—	—	—
9	7,180	6,936	754	2,685	4,624	220	220	182	134	86
State	55,100	48,370	3,219	16,669	31,263	800	800	226	634	666

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

*Includes 30,000 bushels of concrete-constructed storage.

Table 22. On-farm storage facilities for small grains: Capacity by specified characteristics, by crop reporting districts, Mississippi, June, 1958.

District	Wood-constructed					Metal-constructed				
	Total	Weather proof	Rodent proof	Fumigate	Ventilate	Total*	Weather proof	Rodent proof	Fumigate	Ventilate
	Thousand bushels									
1	1,090	1,079	476	1,006	1,049	3,320	3,320	3,127	3,320	3,214
2	35	35	7	17	35	545	545	545	545	545
3	240	240	36	240	240	60	60	60	60	60
4	2,305	2,194	1,448	2,194	2,194	5,055	5,055	4,656	5,055	5,055
5	600	600	120	350	350	100	100	100	100	100
6	690	690	158	464	158	340	340	225	157	297
7	580	580	464	580	580	20	20	12	15	18
8	305	305	40	152	235	15	15	10	11	13
9	455	455	46	441	455	45	45	45	45	45
State	6,300	6,178	2,795	5,444	5,296	9,500	9,500	8,780	9,308	9,347

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

*Includes 15,000 bushels of concrete-constructed storage.

Table 23. Miscellaneous structures used for storing grains on farms: Capacity by specified characteristics, by crop reporting districts, Mississippi, June, 1958.

District	Total*	Weather Proof	Rodent Proof	Fumigate	Ventilate
	Thousand bushels				
1	30	30	—	—	16
2	280	280	—	—	—
3	590	590	—	—	—
4	110	110	—	37	—
5	385	360	—	—	25
6	280	280	—	28	28
7	15	15	—	—	—
8	80	63	6	6	6
9	310	310	—	—	114
State	2,080	2,038	6	71	189

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

*All facilities are of wood construction, except 5,000 bushels of concrete or brick storage.

Table 24. On-farm grain storage: Total capacity and capacity reported as approved for CCC loans, by crop reporting districts, Mississippi, June, 1958.

District	Total	Approved for CCC loans	District	Total	Approved for CCC loans
	Thousand bushels			Thousand bushels	
1	8,340	4,087	6	8,510	485
2	7,160	565	7	5,815	75
3	8,590	405	8	6,700	20
4	11,270	5,635	9	8,210	280
5	9,185	459	State	73,780	12,011

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

Table 25. Percent of farms reporting grain damaged from specified causes and percent of farm-stored grains normally damaged from specified causes, by crop reporting districts, Mississippi, June, 1958.

District	Percent of farms reporting grain damaged by:			Percent of farm-stored grain damaged by:*		
	Rats and Mice	Weevils	Excessive moisture	Rats and Mice	Weevils	Excessive moisture
	Percent					
1	32	32	12.0	8.8	5.7	2.8
2	50	35	2.5	5.9	2.0	0.1
3	48	19	1.9	5.6	1.2	0.1
4	34	21	3.8	6.6	0.6	0.1
5	62	52	14 0	8.4	4.2	1.0
6	44	40	0.6	5.7	4.1	0.1
7	56	54	0.7	10.6	8.5	0.1
8	56	59	7.7	6.4	7.0	0.4
9	37	34	1.8	8.3	6.6	0.4
State	46	38	4.9	7.3	4.6	0.5

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are the result of an enumeration of a representative sample of farms.

*The damage reported can be considered the minimum because many farmers are unaware of the amount of damage to grain, particularly weevil damage and moisture damage to corn in the shuck.

Table 26. Percentage distribution of farm grain storage capacity by data of construction, by specified characteristics, and by kind of storage, Mississippi, June, 1958.

Period of construction	Percentage distribution of capacity by date of construction	Percentage distribution by specified characteristics, by dates: Weather proof	Rat proof	Fumigate	Ventilate
	Percent	Percent	Percent	Percent	Percent
		Ear corn storage capacity			
1940 and earlier	45 4	86.4	4.5	23.1	59.2
1941 - 1945	12 1	89.2	5.0	24.2	44.1
1946 - 1950	19.5	87.6	6 3	41.3	63.3
1951 - 1955	15.0	92.5	7.9	37.2	62.4
1956 - 1958	8.0	94.7	14.2	42.8	63.7
Total	100.0	88.0	5.4	31.5	57.1
		Small grain, shelled corn, soybean and sorghum grain storage capacity			
1940 and earlier	15.5	100.0	14.4	90.2	88.6
1941 - 1945	6.4	89.6	27 1	46.9	63.5
1946 - 1950	15.0	100.0	59.5	96.9	100.0
1951 - 1955	50.9	100.0	90.9	99.6	95.2
1956 - 1958	12.2	99.5	70.1	91.8	97.8
Total	100.0	99.2	67.7	93.4	92.9
		Miscellaneous storage capacity			
1940 and earlier	85.8	97.6	—	—	8.5
1941 - 1945	10.6	100.0	—	4.8	4.8
1946 - 1950	0 8	100.0	—	66.7	100.0
1951 - 1955	2.5	100.0	—	100.0	—
1956 - 1958	0 3	100.0	100.0	100.0	100.0
Total	100.0	98.0	0.3	3 4	9.1
		Total grain storage capacity			
1940 and earlier	40.0	88.3	5.0	27.4	58.6
1941 - 1945	10 8	89.5	3.5	26.6	45.5
1946 - 1950	18.0	89.8	16.0	51.5	70.0
1951 - 1955	22.5	96.2	49.0	68.4	78.4
1956 - 1958	8.7	96.2	31.4	57.9	74.2
Total	100 0	90.7	19.0	44.0	63.4

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

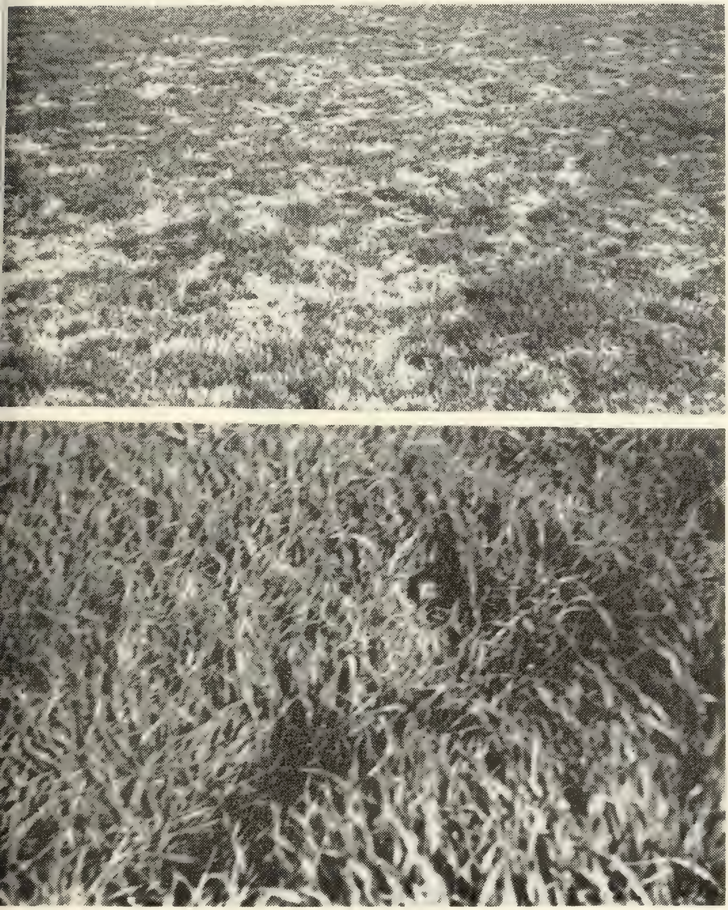
Table 27. Additional grain storage space reported as needed on farms and capacity expected to be added in 1958, by crop reporting districts, Mississippi, June, 1958.

	Additional space needed			Capacity to be added in 1958: Ear corn			Small grain, shelled corn soybeans, sorghums			
District	Corn	Small grain shelled corn soybeans sorghums	Total	New construction	Altering present facilities	Total	New construction	Altering present facilities	Total	Total
				Thousand bushels						
1	300	90	390	50	30	80	30	—	30	110
2	670	180	850	430	40	470	170	—	170	640
3	560	490	1,050	160	50	210	45	—	45	255
4	400	1,200	1,600	350	10	360	500	—	500	860
5	720	20	740	300	20	320	10	—	10	330
6	700	400	1,100	650	20	670	140	—	140	810
7	150	50	200	140	—	140	—	—	—	140
8	650	170	820	220	20	240	5	—	5	245
9	350	—	350	100	10	110	—	—	—	110
State	4,500	2,600	7,100	2,400	200	2,600	900	—	900	3,500

Source: Mississippi Crop and Livestock Reporting Service, Jackson, Mississippi. The data are estimates based on an enumeration of a representative sample of farms.

BULLETIN 602 JULY 1960

Leaf Blotch Disease Of Oats



And Its Control

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AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

SUMMARY AND CONCLUSIONS

1. The leaf blotch disease of oats caused by **Helminthosporium avenae** is described and its importance in Mississippi is emphasized. No commercial varieties resistant to leaf blotch are available.

2. Good control has been achieved for the production of fall-sown oats for grazing by properly treating the seed with Ceresan M, 1/2 oz. per bu.

3. The seed treatment greatly eliminated or considerably delayed the appearance of the disease. It did not protect the crop throughout the season because of secondary infections that occurred in the spring.

4. It is suggested that growers purchase their seed already treated, preferably certified.

5. Treatment of seed in the seed box of the drill is necessary if no commercially treated seed is available.

6. Planting untreated seed may invite great risks of crop failure.

Figure 1. View of two adjoining fields of oats, variety Nortex 107, both planted at the same time with seed of the same source. Upper view — seed not treated, note gaps in the poor stand. Lower view — seed treated with Ceresan M; this field provided good grazing and produced fair yield of grain.

THE LEAF BLOTCH DISEASE OF OATS AND ITS CONTROL

By S. S. IVANOFF and CLYDE L. BLOUNT

During the last few years weather conditions in Mississippi have been such that many young stands of oats planted primarily for grazing have been lost from diseases. For the same reason grain yields have also been low at many locations, particularly in the southern part of the State, and much seed infection and contamination have resulted during the ripening period. Two main diseases have been involved, namely, Victoria blight and leaf blotch. Victoria blight may be controlled by the use of resistant varieties, such as Delta Red 88, Nortex 107, Delair, Mid-South, Moregrain, and Suregrain. There are no varieties resistant to leaf blotch, however. The purpose of this bulletin is to describe this disease as it occurs in Mississippi and to present data on its control by chemical seed treatment.

The fungus organism causing leaf blotch **(Helminthosporium avenae)** is an old parasite known for over 70 years. For a long time the disease was not considered important in the United States and little attention was paid to it. It is in recent years that the damage caused by it has become noticeable and at some locations has been very serious to fall-sown oats planted for grazing as well as to oats planted for grain. This change in the severity of the disease may possibly be explained by the unusually high rainfall during the last few years, since abundant moisture is the primary factor in its incidence and spread.

Another probable factor is that new and more potent strains of this particular species of parasite may have arisen which are capable of inducing the disease more quickly and in more destructive form. Laboratory and greenhouse tests have confirmed the existence of great differences in disease-producing capacity among the various fungus isolates ob-

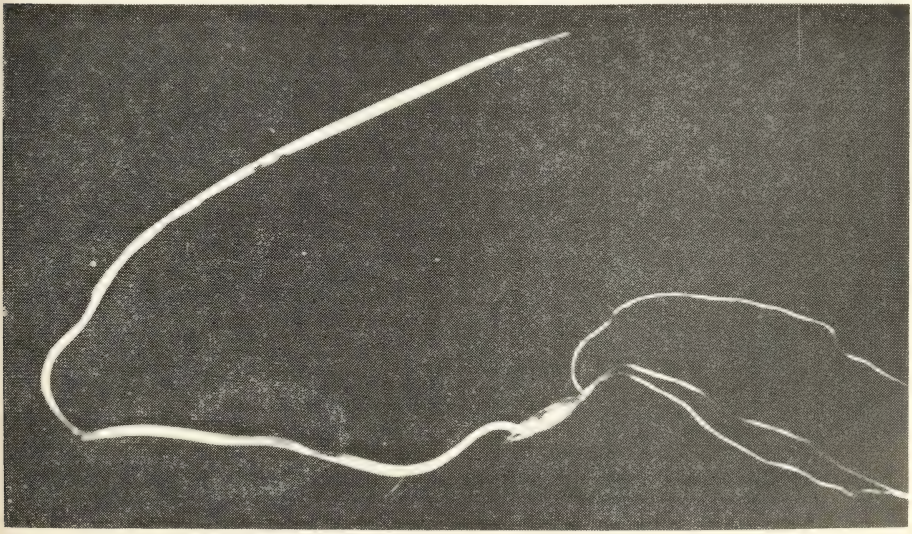

Figure 2. Oat seedling 12 days old showing a dark lesion (sometime streaked) on the coleoptile and two small spots on the first leaf. These symptoms were induced in the laboratory by artificially inoculating the seed with pure cultures of the fungus.

tained from naturally infected seed and other oat material grown in Mississippi and other southern states. Evidence is also increasing about the existence of other species of **Helminthosporia**, that are morphologically different from the well known **H. avenae**, and which seem capable of inducing much the same disease symptoms on oats.

The fungus is carried mainly on the seed but may also be carried on the stubble and other plant refuse left in the field from previous croppings. It is not known to live in the soil for any length of time, as other parasites do. However, contaminated or infected seed is the main concern.

Primary infection starts as soon as the seed begins to germinate under conditions of abundant soil moisture and moderate temperatures. In laboratory and greenhouse trials it has been established that the best conditions for seedling infection are a temperature ranging from 75 to 82°F, and a very high relative humidity with some excess moisture. The fungus on the seed may be located on the glumes, and between the glumes and the kernel, and sometimes within the kernel proper.

In the germination of the seed the roots develop first, approximately 2 to 3 days after it is planted, if the growing conditions are ideal. Three to five days later, the young shoot protrudes through the seed coat, but still remains underground. The shoot consists of the coleoptile, a

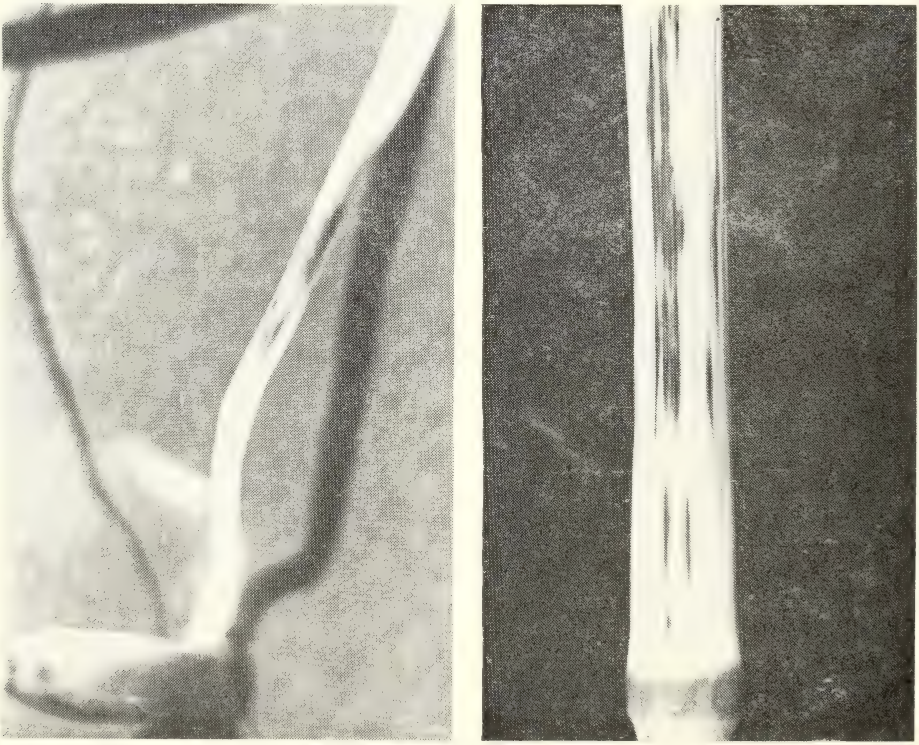

Figure 3. Left: Another very young oat seedling showing the first symptoms of infection in the form of long dark streaks just above the kernel. Right: The same streaks, causing dry rot, as they appeared 7 months later on the mature stem or culm.

membranous leaf-like structure, one to two inches long, which envelops like a gloved finger the embryonic stem and true leaves inside. It is at the moment when the shoot breaks through the seed coat that infection of the young seedling begins to take place.

The development of this infection is as follows: The growing shoot at the very beginning must pass by the glumes, which have sharp, scratching points and edges, while the coleoptile is tender, thin, and almost transparent. The coleoptile, as it grows, is forced to rub itself against the edges of the glumes, thus suffering wounds and bruises in the form of minute punctures and streaks. Also at this time the various parts of the fungus that are within or lodged between the glumes "lie in wait" to gain entrance into the young shoot as soon as it is wounded and to invade its tissue. Through the coleoptile the infection reaches the first true leaf, forming one or more brown lesions.

By the time the top of the seedling reaches above ground, some 10 to 12 days after planting, the young stem also shows symptoms of infection in the form of dark lesions or streaks, just above the kernel (Fig. 2).[1] It is of interest that the same dark streaks induced so early on the very young and short underground stem persist and elongate, and develop later into a culm rot condition of the mature plant (Fig. 3). If at this early stage the conditions for the development of the disease continue to be favorable, and the disease-producing fungus is of high potency, then the seedling rots at the base very quickly and is killed before it has ever had an opportunity to emerge above the ground (Fig. 4). By this time the primary roots also begin to show a decay usually near the base of the kernel which in some measure contributes to the trials of the striving plant.

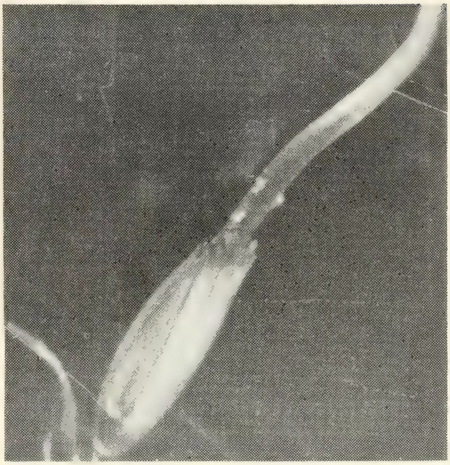

Figure 4. Severe rotting (dark area) on very young oat seedling, just above the seed coat, showing some fungus growth. Such rotting may occur before or shortly after the seedling emerges from the ground, leaving gaps in the field.

This failure to emerge has been often observed in many commercial fields in south Mississippi and sometimes in other parts of the state, particularly in the early planted oats. Frequently, however, a young stand of oats may appear, and even though the plants are infected, they give the illusion of health, since they seem at first green, because the lesions on the first leaves are rather small and inconspicuous.

All of these developments have been studied in the field and have been reproduced with remarkable similarity in the laboratory and in the greenhouse by artificial inoculation techniques. The symtoms of leaf blotch are distinct from those of Victoria blight. (4).

Secondary infection, given the proper conditions, may occur about two weeks after the first stand has been more or less established. The new leaves become infected from the old ones, the blotches now appearing longer. Eventually the plants are killed before much grazing has been obtained. Following warm

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[1] Other workers (9) have previously observed the formation of the dark lesion on the coleoptile of young seedlings in the field and have considered it as a constant symptom of the disease.

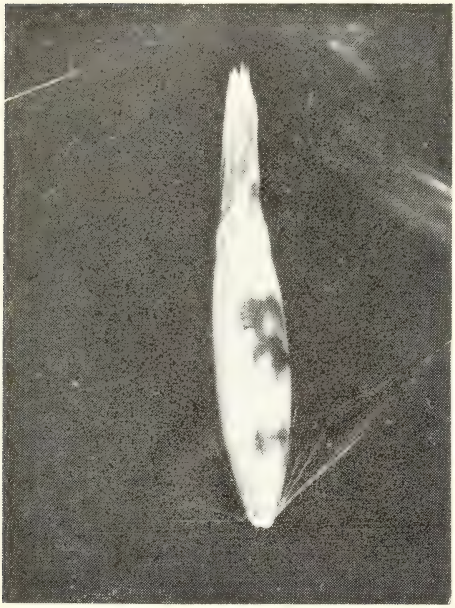

Figure 5. A mature oat seed, greatly enlarged, showing infection by the blotch fungus. This type of infection may go deep into the kernel and is difficult to eliminate by seed treatment. Consequently, badly infected seed crop should not be used for planting.

showers in the spring, surviving plants may become further infected, causing discoloration (pinking, purpling, then blackening) of leaf sheaths and stems, dry-rotting of same, spotting of the glumes, infection of flowers resulting in abortion, and of course, great reduction in grain yields (Fig. 5 and 6). These changes take place gradually and are frequently unnoticed by the average grower, except for the general poor appearance of the crop by harvest time. In the absence of rains or heavy dews the disease does not develop so quickly and the above damage may be light or completely absent. A good healthy stand may be had and good grazing assured without leaf blotch, if clean, healthy, or treated seed is used for planting.

Control of Leaf Blotch by Seed Treatment

Seed treatment of oats with vaporizing organic mercury compounds in the form of dusts or liquids for the control of some smuts and other seedborne diseases has been recommended for some time. The reports on control have been variable, but on the whole encouraging. It was thought necessary, however, to reinvestigate critically this measure of control because of the possibility that there are new strains of parasites, in view of the unprecedented severity of this disease.

Laboratory trials were first conducted with locally grown seed thoroughly infested with the causal organism. The seed was treated with Ceresan M[2] dust at the rate of 1/2 oz. per bushel as recommended by the manufacturer. For checks, healthy seeds were used from a field kept free from the disease. After 3 trials with a total of 30 replications and under conditions most favorable for the disease, it was established that complete control may be achieved by this

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[2] Active ingredients: Ethyl, mercury, T-toluene, sulfonanilide 7.7%; (Total mercury as metallic 3.2%). Inert ingredients 92.3%.

Table 1. Control of leaf blotch of oats (Helminthosporium avenae) by seed treatment with Ceresan M, ½ oz. to the bushel.

	Untreated		Treated	
Kind of seed employed	Germination %	Healthy plants obtained %	Germination %	Healthy plants obtained %
Lot 1. Oat seeds naturally infected with leaf blotch	98	33	100	100
Lot 2. Healthy seeds with no disease-producing fungi on them	95	95	95	95

method (Table 1). It was kept in mind, however, that even though the fungus mycelium had invaded the glumes of the seeds used in these trials, and its spores were found upon the surfaces and between the surfaces of the various parts of the seed, still there may be some rare instances in which the parasite has deeply invaded the seed, in which cases the seed treatment may not be one hundred percent effective.

In field tests with small replicated plots, the treated seed gave a good healthy stand, but some disease appeared at about maturity, probably because of contamination from nearby diseased oats. The untreated seed under wet conditions produced rather poor stands, small unthrifty plants, with the disease becoming evident early, reducing the grain yield in some cases very considerably.

A study was made of fourteen commercial oat fields in 1959-1960 in Pearl River County, in south Mississippi, in order to determine the effect of treated and non-treated commercial seed planted in the fall. Plantings in this part of the State had been particularly disappointing in recent years because of frequent destruction of the young crop stands. The results may be summarized as follows:

(1) Treated seed invariably gave good stands; untreated seed gave poor stands;

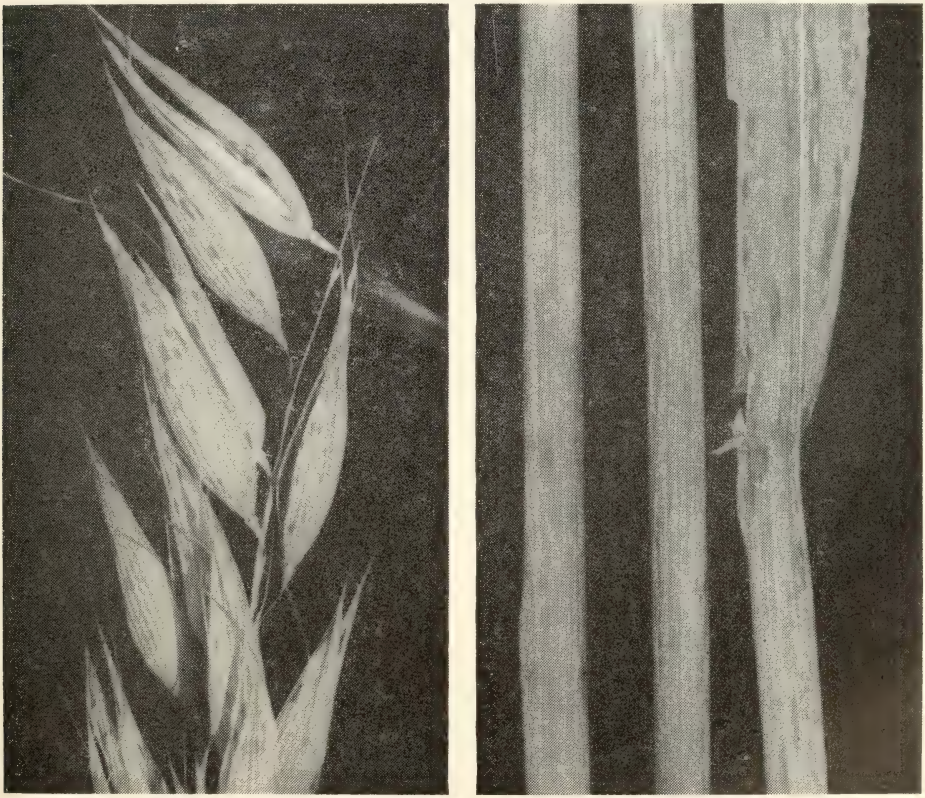

Figure 6. Maturing grain and stems of oats infected with leaf blotch. The fungus is spread from plant to plant, and from field to field, by wind and splashing rains. The disease is transmitted through the seed unless the seed is chemically treated.

(2) treated seed did not control leaf blotch one hundred percent, but the limited extent of the disease found did not materially reduce the quality or quantity of grazing; (3) fields planted with treated seed and harvested for grain after grazing, produced a fair to good crop of grain; (4) none of the fields planted with untreated seed reached satisfactory maturity. Early planted oats seemed to be damaged more severely than late planted oats. It was further observed that aphids or "green bugs" **(Toxoptera graminum)** were more destructive on the unthrifty plants grown from untreated seed.

Growers should use treated seed to avoid serious losses. Besides Ceresan M, Panogen is also used (3/4 oz. per bu.) for general purpose seed treatments, but this material was not included in the tests. The seed may be treated by commercial houses, but in cases where this has not been done, instead of planting the untreated seed, the practice by some growers of treating the seed in the drill box may be followed, being certain to take ordinary precautions against harm to the operator. About one-half of the seed is spread in the drill box, then one-half of the Ceresan M is dusted over it. The rest of the seed is added and the remainder of the fungicide again spread on top. The mixture is stirred as well as possible and drilled. A waiting period of some minutes between stirring and planting may be of benefit.

Just as varieties resistant to Victoria blight were produced through breeding, so resistance to leaf blotch may eventually be obtained through breeding. This would be the best solution to this problem. In the meantime it may be said: plant treated seed of an adapted variety and avoid planting oats on low, wet land.

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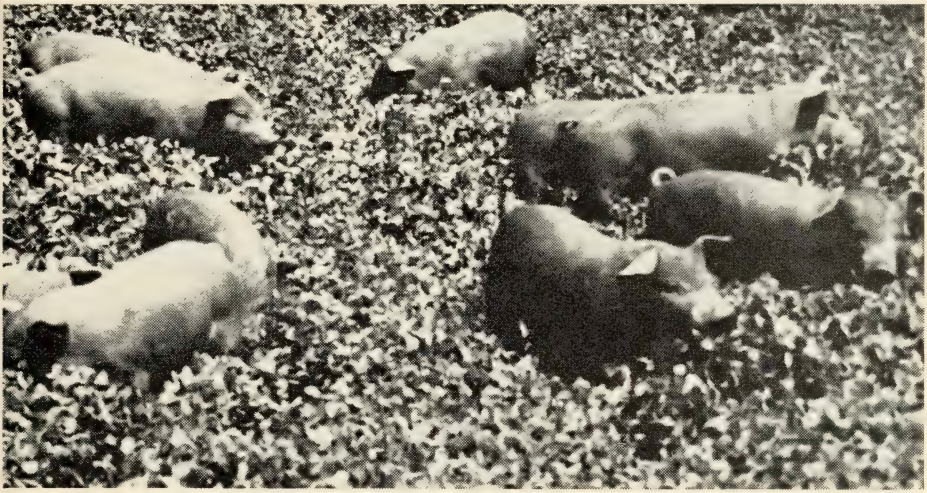
BULLETIN 603 SEPTEMBER 1960

How Much For Feeder Pigs?



MISSISSIPPI STATE UNIVERSITY

AGRICULTURAL EXPERIMENT STATION

CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

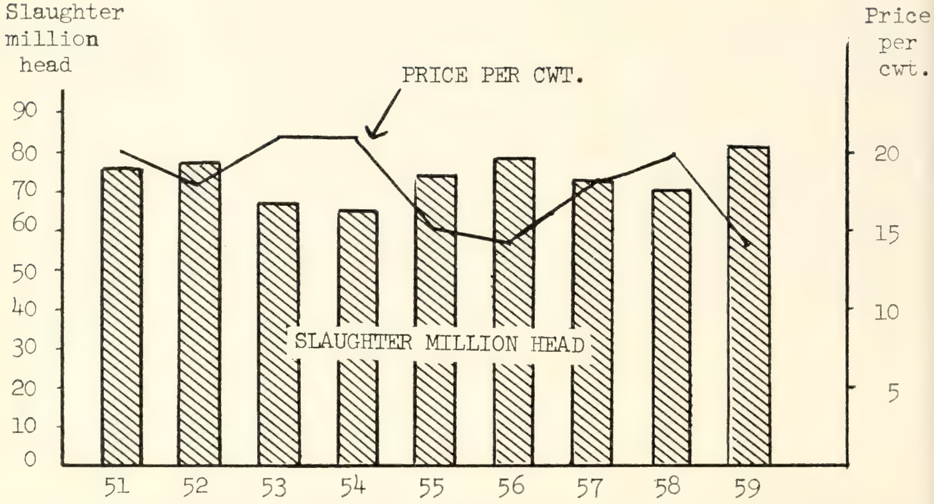


Figure 1. Commercial hog slaughter and prices received by farmers, United States,

HOW MUCH FOR FEEDER PIGS?

By JAMES H. SIMPSON, JR., and W. L. RICHMOND*

I. Trends in Hog Production

Commercial production of hogs is a growing part of Mississippi's agriculture. During the past few years, there have been gains in hog production and marketings and in cash income received by farmers from the sale of hogs (Table 1). This rising wave of interest has focused the attention of hog producers on the feeder pig situation in the state.

A producer has only two sources of feeder pigs. He must either maintain a sow herd and produce his own feeders or depend on local markets to supply his needs. The present trend is toward specialization, and many producers feel that the most economical use of their resources is in a straight feeding operation rather than in a combined farrowing-feeding system. Therefore, these producers are interested in buying the disease-free, meat-type feeder pigs that several markets in the state are attempting to supply.

Both the feeder-pig producer and the hog feeder are interested in the market price of feeder-pigs. The producer wants a price high enough to allow sufficient returns to his labor and capital investment, while the feeder wants a price low enough to allow a margin of profit on his feeding operation. This points up the question, "How much for feeder pigs?

II. Costs of Producing Slaughter Hogs

The hog producer must consider expected costs and returns very carefully when buying feeder pigs or when making a decision whether to sell or feed-out pigs he has raised.

Feed costs: Since the cost of grain and protein-mineral supplement makes up 70 to 75 percent of the total cost involved in growing-out slaughter hogs from feeder pigs the price of feed and the amount needed to produce a market hog are of first importance.

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*Assistant Agricultural Economist, Mississippi Agricultural Experiment Station and Associate Extension Animal Husbandman, respectively

Table 1. Hog production, marketings, and income, Mississippi, 1955-59.

Year	Production[1]	Marketings[2]	Price per 100 lbs.	Cash receipts[3]
	1,000 lbs.	1,000 lbs.	Dollars	$1,000
1955	158,990	80,055	15.20	12,950
1956	159,948	106,303	13.40	14,889
1957	161,081	123,896	16.40	21,179
1958	170,290	129,150	18.50	24,889
1959	211,391	133,326	13.90	19,469

[1] Adjustment made for in-shipments and changes in inventory.

[2] Excludes interfarm sales.

[3] Includes receipts from marketings and sales of farm slaughtered meat.

Table 2. Costs other than feed required to raise feeder pigs of various weights to 225 pounds.

Weight of feeders	Cash cost[1]	Non-cash cost[2]	Total cost
(lbs.)			
40	$4.00	$5.00	$9.00
60	3.80	4.70	8.50
80	3.60	4.40	8.00
100	3.40	4.10	7.50

[1] Veterinary fees and medical expenses, salt, feed grinding and mixing, repair on buildings and equipment, water, electricity, hauling, and commission fees.

[2] Death losses, depreciation on buildings and equipment, interest on invested capital, labor, and marketing.

Table 3. Amount and cost[1] of protein-mineral supplement required to raise feeder pigs to 225 lbs. at three levels of feed conversion.

Pounds of feed per 100 pounds of pork	Weight of feeders 40 Supplement	40 Cost	60 Supplement	60 Cost	80 Supplement	80 Cost	100 Supplement	100 Cost
	(lbs.)	($)	(lbs.)	($)	(lbs.)	($)	(lbs.)	($)
400	126	5.67	112	5.04	99	4.46	85	3.82
350	110	4.95	98	4.41	86	3.87	74	3.33
300	94	4.23	84	3.78	74	3.33	64	2.88

[1] $4.50 per cwt.

Other costs: The other 25 to 30 percent of total production costs are made up of such items as labor, veterinary fees, repairs and depreciation on buildings and equipment, and interest on invested capital. Although these costs will vary from farm to farm, they are directly related to the length of the feeding period. That is, less labor, interest, etc. will be required to finish-out a 100 lb. feeder than one which is started on feed at 40 lbs. Table 2 contains estimates of these other costs of production and indicates how they are affected by the length of the feeding period.

Protein-mineral supplement: A hog feeding ration must be supplemented with protein and minerals for economical gains. The price of these supplements is relatively stable and does not make up as large a part of total feed costs as does corn. Therefore, the composite price of protein and mineral supplement used in computing the feeding costs was held constant at $4.50 per hundredweight. Table 3 indicates the amount and cost of supplement required for feeding hogs to slaughter weights at various rates of feed conversion.

Feeder-price tables: All the information concerning type and quantity of feed required, feed cost, and other costs involved in the production of slaughter hogs has been incorporated in Tables 4 through 7. By using these tables, a producer can estimate the price he can afford to pay for feeder pigs of various weights at specified prices for corn and slaughter hogs. The tables are also divided into three representative rates of feed conversion so that a producer may tailor his estimates to his own individual conditions.

Three questions: Before using these feeding tables, a producer must answer three questions concerning his individual feeding operation. These questions are: (1) What is the value per bushel of the corn he is feeding? (2) How many pounds of feed will be required to produce a pound of pork? and (3) What will be the selling price of slaughter hogs at the end of his feeding period?

The answer to the first question should be the farm value of corn, that is, delivered price for purchased corn or market price less transportation and marketing charges for corn that is produced on the farm. A producer can use his previous feeding experience, that of his neighbors, or depend upon published experimental information as a basis for estimating his expected rate of feed conversion.

Section III of this publication contains some information that should prove helpful in estimating expected prices for slaughter hogs.

How to use the tables: As an example of the way in which these tables may be used, suppose a producer is considering buying 40-pound feeder pigs to feed out to 225 pounds. If he estimates that his corn is worth $1.10 per bushel, that he can produce 100 pounds of pork with 350 pounds of feed, and that slaughter hogs will be selling for around $18.00 per cwt. at the end of his feeding period, then Table 4 holds an answer for him.

By looking under the heading of corn

at $1.10 per bushel, down to the line across from the $18.00 expected selling price in the "350 pounds of feed per 100 pounds of pork" section of the table, he will find a price per head of $15.98. This means that if his estimates of corn and hog prices and feed conversion rates are correct, he could afford to pay as much as $15.98 for a 40-pound feeder pig and still cover all costs involved in carrying it to market weight.

To make a profit from his feeding operation, he will have to buy 40-pound feeder for **less** than $15.98. If he has raised 40-pound feeder pigs and can sell them for **more** than $15.98, selling them would be more profitable than feeding them out.

III. Hog Slaughter and Price

Slaughter-price relationships: In order to use the feeder price tables effectively, a producer must be able to accurately estimate the price he will receive for his slaughter hogs at the end of the feeding period. There are several factors which affect hog prices, but the most important cause of ups and downs in the hog market is fluctuations in the national rate of hog slaughter. Figure 1 shows the effect of changes in commercial hog slaughter in the U.S. on the prices received by farmers during the same period.

A **one percent** change from the year before in the number of hogs slaughtered was accompanied by an average price change of **two percent** in the opposite direction. That is, a 10% **increase** in the yearly slaughter rate was accompanied by an average 20% **decrease** in the price farmers received for their hogs. Of course, this average relationship did not hold true every year, but Figure 1 illustrates the

Table 4. Estimated price that can be paid for 40-pound feeder pigs with specified prices for corn and slaughter hogs at three rates of feed conversion.

Pounds of feed per 100 pounds of pork	Expected price per cwt. for 225 lb. hogs.	Price of corn per bushel (cents)							
		80	90	100	110	120	130	140	150
		Price per head for feeder pigs (dollars)							
400	$10	--------	--------	--------	--------	--------	--------	--------	--------
	12	3.56	2.46	1.36	.27	--------	--------	--------	--------
	14	8.06	6.96	5.86	4.77	3.67	2.58	1.48	.38
	16	12.56	11.46	10.36	9.27	8.17	7.08	5.98	4.88
	18	17.06	15.96	14.86	13.77	12.67	11.58	10.48	9.38
	20	21.56	20.46	19.36	18.27	17.17	16.08	14.98	13.88
	22	26.06	24.96	23.86	22.77	21.67	20.58	19.48	18.38
	24	30.56	29.46	28.36	27.27	26.17	25.08	23.98	22.88
350	10	.86	--------	--------	--------	--------	--------	--------	--------
	12	5.36	4.40	3.44	2.48	1.52	.56	--------	--------
	14	9.86	8.90	7.94	6.98	6.02	5.06	4.10	3.14
	16	14.36	13.40	12.44	11.48	10.52	9.56	8.60	7.64
	18	18.86	17.90	16.94	15.98	15.02	14.06	13.10	12.14
	20	23.36	22.40	21.44	20.48	19.52	18.56	17.60	16.64
	22	27.86	26.90	25.94	24.98	24.02	23.06	22.10	21.14
	24	32.36	31.40	30.44	29.48	28.52	27.56	26.60	25.64
300	10	2.68	1.86	1.04	.22	--------	--------	--------	--------
	12	7.18	6.36	5.54	4.72	3.89	3.07	2.25	1.42
	14	11.68	10.86	10.04	9.22	8.39	7.57	6.75	5.92
	16	16.18	15.36	14.54	13.72	12.89	12.07	11.25	10.42
	18	20.68	19.86	19.04	18.22	17.39	16.57	15.75	14.92
	20	25.18	24.36	23.54	22.72	21.89	21.07	20.25	19.42
	22	29.68	28.86	28.04	27.72	26.39	25.57	24.75	23.92
	24	34.18	33.36	32.54	31.72	30.89	30.07	29.25	28.42

fact that each change from one year to the next in slaughter rates did result in a price change in the opposite direction.

Farrowing plus 6 mo. equals slaughter: Since the slaughter rate seems to have such an effect on price, the next problem is how to estimate future slaughter.

Hog slaughter during any particular period is made up almost entirely of pigs farrowed roughly six months earlier. Pigs farrowed in the spring are usually slaughtered in the fall, while fall-farrowed pigs make up the bulk of spring slaughter the following year.

Therefore, any change in the number of pigs farrowed will probably be followed by a similar change in the slaughter rate six months later. Estimates of the number of pigs farrowed in the country are usually available to producers from several sources. Extension workers, national farm magazines, the U.S. Department of Agriculture, and other agencies attempt to give wide circulation to this information which can be so important to hog producers.

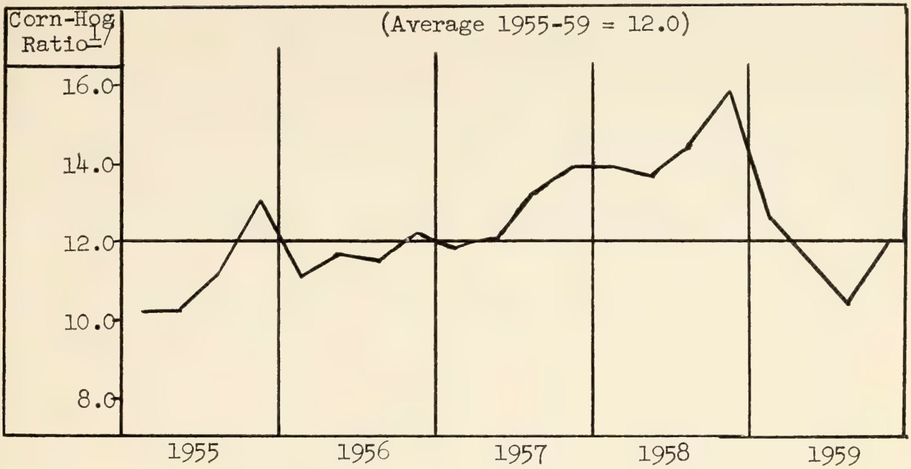
Corn-hog ratio: Farrowing rates can give the hog producer an idea of expected slaughter six months in advance, but the corn-hog ratio can give an indication of changes in the more distant future.

This ratio takes into consideration both hog and corn prices and is expressed as the number of bushels of corn required to be equal in value to 100 lbs. of hog, liveweight. For example, if the average price of hogs is $14 per 100 lbs. and corn is $1.00 per bushel, the corn-hog ratio would be $14 divided by $1.00 or 14.0.

Figure 2 illustrates the way the Mississippi corn-hog ratio has fluctuated in recent years. The average ratio over the

Table 5. Estimated price that can be paid for 60-pound feeder pigs with specified prices for corn and slaughter hogs at three rates of feed conversion.

Pounds of feed per 100 pounds of pork	Expected price per cwt. for 225 lb. hogs.	Price of corn per bushel (cents)							
		80	90	100	110	120	130	140	150
		Price per head for feeder pigs (dollars)							
400	$10	1.13	.15	......	......	......	......	......	......
	12	5.63	4.65	3.67	2.70	1.72	.74	......	......
	14	10.13	9.15	8.17	7.20	6.22	5.24	4.26	3.28
	16	14.63	13.65	12.67	11.70	10.72	9.74	8.76	7.78
	18	19.13	18.15	17.17	16.20	15.22	14.24	13.26	12.28
	20	23.63	22.65	21.67	20.70	19.72	18.74	17.76	16.78
	22	28.13	27.15	26.17	25.20	24.22	23.24	22.26	21.28
	24	32.63	31.65	30.67	29.70	28.72	27.74	26.76	25.78
350	10	2.73	1.88	1.02	.16	......	......	......	......
	12	7.23	6.38	5.52	4.66	3.80	2.95	2.09	1.23
	14	11.73	10.88	10.02	9.16	8.30	7.45	6.59	5.73
	16	16.23	15.38	14.52	13.66	12.80	11.95	11.09	10.23
	18	20.73	19.88	19.02	18.16	17.30	16.45	15.59	14.73
	20	25.23	24.38	23.52	22.66	21.80	20.95	20.09	19.23
	22	29.73	28.88	28.02	27.16	26.30	25.45	24.59	23.73
	24	34.23	33.38	32.52	31.66	30.80	29.95	29.09	28.23
300	10	4.35	3.62	2.88	2.15	1.41	.68	......	......
	12	8.85	8.12	7.38	6.65	5.91	5.18	4.44	3.71
	14	13.35	12.62	11.88	11.15	10.41	9.68	8.94	8.21
	16	17.85	17.12	16.38	15.65	14.91	14.18	13.44	12.71
	18	22.35	21.62	20.88	20.15	19.41	18.68	17.94	17.21
	20	26.85	26.12	25.38	24.65	23.91	23.18	22.44	21.71
	22	31.35	30.62	29.88	29.15	28.41	27.68	26.94	26.21
	24	35.85	35.12	34.38	33.65	32.91	32.18	31.44	30.71



1/ Bushels of corn required to equal value of 100 pounds of hog, liveweight.

Figure 2. Mississippi corn-hog ratio, by quarters, 1955-59. 1951-59.

Table 6. Estimated price that can be paid for 80-pound feeder pigs with specified prices for corn and slaughter hogs at three rates of feed conversion.

Pounds of feed per 100 pounds of pork	Expected price per cwt. for 225 lb. hogs.	Price of corn per bushel (cents)							
		80	90	100	110	120	130	140	150
		Price per head for feeder pigs (dollars)							
	$10	3.17	2.31	1.45	.59	------	------	--------	--------
	12	7.67	6.81	5.95	5.09	4.23	3.38	2.52	1.65
	14	12.17	11.31	10.45	9.59	8.73	7.88	7.02	6.15
	16	16.67	15.81	14.95	14.09	13.23	12.38	11.52	10.65
400	18	21.17	20.31	19.45	18.59	17.73	16.88	16.02	15.15
	20	25.67	24.81	23.95	23.09	22.23	21.38	20.52	19.65
	22	30.17	29.31	28.45	27.59	26.73	25.88	25.02	24.15
	24	34.67	33.81	32.95	32 09	31.23	30.38	29.52	28.65
	10	4.60	3.85	3.09	2.34	1.59	.84	.08	--------
	12	9.10	8.35	7.59	6.84	6.09	5.34	4.58	3.83
	14	13.60	12.85	12.09	11.34	10.59	9.84	9.08	8.32
	16	18.10	17.35	16.59	15.84	15.09	14.34	13.58	12.82
350	18	22.60	21.85	21.09	20.34	19.59	18.84	18.08	17.32
	20	27.10	26.35	25.59	24.84	24.09	23.34	22.58	21.82
	22	31.60	30.85	30.09	29.34	28.59	27.84	27.08	26.32
	24	36.10	35.35	34.59	33.84	33.09	32.34	31.58	30.82
	10	6.01	5.37	4.72	4.08	3.43	2.79	2.15	1.50
	12	10.51	9.87	9.22	8.58	7.93	7.29	6.65	6.00
	14	15.01	14.37	13.72	13.08	12.43	11.79	11.15	10.50
	16	19.51	18.87	18.22	17.58	16.93	16.29	15.65	15.00
300	18	24.01	23.37	22.72	22.08	21.43	20.79	20.15	19.50
	20	28.51	27.87	27.22	26.58	25.93	25.29	24.65	24.00
	22	33.01	32.37	31.72	31.08	30.43	29.79	29.15	28.50
	24	37.51	36.87	36.22	35.58	34.93	34.29	33.65	33.00

past ten years has been 12.0 and over this same period, a ratio of 12.8 or above has been followed by an increase in farrowings.

Proper interpretation of this chain of relationships, from an increase in the corn-hog ratio to an increase in the number of pigs farrowed followed by an increase in the slaughter rate and a decrease in hog prices, can give the hog producer a sound basis for estimating the market price of his finished feeders.

Table 7. Estimated price that can be paid for 100-pound feeder pigs with specified prices for corn and slaughter hogs at three rates of feed conversion.

Pounds of feed per 100 pounds of pork	Expected price per cwt. for 225 lb. hogs.	Price of corn per bushel (cents)							
		80	90	100	110	120	130	140	150
		Price per head for feeder pigs (dollars)							
400	$10	5.25	4.51	3.77	3.03	2.29	1.55	.80	.06
	12	9.75	9.01	8.27	7.53	6.79	6.05	5.30	4.56
	14	14.25	13.51	12.77	12.03	11.29	10.55	9.80	9.06
	16	18.75	18.01	17.27	16.53	15.79	15.05	14.30	13.56
	18	23.25	22.51	21.77	21.03	20.29	19.55	18.80	18.06
	20	27.75	27.01	26.27	25.53	24.79	24.05	23.30	22.56
	22	32.25	31.51	30.77	30.03	29.29	28.55	27.80	27.06
	24	36.75	36.01	35.27	34.53	33.79	33.05	32.30	31.56
350	10	6.47	5.82	5.17	4.52	3.87	3.22	2.57	1.92
	12	10.97	10.32	9.67	9.02	8.37	7.72	7.07	6.42
	14	15.47	14.82	14.17	13.52	12.87	12.22	11.57	10.92
	16	19.97	19.32	18.67	18.02	17.37	16.72	16.07	15.42
	18	24.47	23.82	23.17	22.52	21.87	21.22	20.57	19.92
	20	28.97	28.32	27.67	27.02	26.37	25.72	25.07	24.42
	22	33.47	32.82	32.17	31.52	30.87	30.22	29.57	28.92
	24	37.97	37.32	36.67	36.02	35.37	34.72	34.07	33.42
300	10	7.68	7.12	6.57	6.01	5.46	4.90	4.34	3.79
	12	12.18	11.62	11.07	10.51	9.96	9.40	8.84	8.29
	14	16.68	16.12	15.57	15.01	14.46	13.90	13.34	12.79
	16	21.18	20.62	20.07	19.51	18.96	18.40	17.84	17.29
	18	25.68	25.12	24.57	24.01	23.46	22.90	22.34	21.79
	20	30.18	29.62	29.07	28.51	27.96	27.40	26.84	26.29
	22	34.68	34.12	33.57	33.01	32.46	31.90	31.34	30.79
	24	39.18	38.62	38.07	37.51	36.96	36.40	35.84	35.29

Bulletin 604 September 1960

INCOMES AND RESOURCES OF RURAL FAMILIES

in the Clay-Hills Area of Mississippi

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

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INCOMES AND RESOURCES OF RURAL FAMILIES IN THE CLAY-HILLS AREA OF MISSISSIPPI

John C. Crecink and Herbert Hoover*

IMPLICATIONS

The primary objective of this study was to ascertain and describe the sources and levels of income of open-country rural families in the Clay-Hills Area of Mississippi[1] in relation to the physical and human resources of these families.

The farms in the study represented, on a sample basis, 59,000 open-country rural families, or about 218,000 persons. Information obtained on the sample farms indicates that in 1958 approximately 40,000 of the area's open-country rural families were farm families, and 19,000 were rural nonfarm families (Table 1). However, only about 12,500 of the farm families were wholly dependent upon farming for their livelihood. Another 10,800 families received more income from farming than from other sources and the remaining 16,700 farm families received more from nonfarm sources than from farming. Off-farm work was the major income source for approximately 23,500 (40 percent) of the rural families, and nearly 27,000 (45 percent) received income from the off-farm work of family members. Income from retirement, pensions, rents, welfare, and other nonwork sources was the major income source for about one family in four and the sole income of one in six families.

One of every three open-country families, or more than 19,000 such families, received net money income of less than $1,000; and only one family in 16, or slightly under 3,600 families received more than $5,000 net money income. It is obvious that the low-income problem is not exclusively a farm problem, as one-third or more of the families in both the farm and nonfarm groups had net money incomes under $1,000. However, two groups of families, full-time farm and nonfarm welfare, while constituting only about one-third of the rural families, contained almost 62 percent of the families in this very low-income group. In terms of employment potential, the family heads of slightly over 9,000 (47 percent) of these families with extremely low

Table 1. Estimated total number of open-country rural families by family class and by specified level of income, Clay-Hills Area of Mississippi, 1958.[1]

Family classification	Estimated number of families	Level of family net money income					
		Under $1000	$1000-$1999	$2000-$2999	$3000-$3999	$4000-$4999	$5000 or more
				Number			
Total, farm	39,750	12,057	13,250	7,420	3,312	1,458	2,253
Full-time	14,070	6,900	5,177	1,327	266	—	400
Part-time:							
Head works off-farm	7,670	790	2,247	2,250	1,720	265	398
Others work off-farm	6,480	391	1,585	1,723	796	795	1,190
Nonwork income	11,530	3,976	4,241	2,120	530	398	265
Total, nonfarm	19,250	7,097	4,081	3,460	1,774	1,508	1,330
Off-farm work	9,665	529	1,951	2,927	1,686	1,331	1,241
Nonwork income:							
Welfare	6,485	4,975	1,155	267	88	—	—
Other	3,100	1,593	975	266	—	177	89
All open country	59,000	19,154	17,331	10,880	5,086	2,966	3,583

[1] Expanded from survey sample of 517 rural families.

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* Agricultural Economists, Farm Economics Research Division, Agricultural Research Service, U. S. Department of Agriculture, cooperating with the Mississippi Agricultural Experiment Station.

[1] Includes census economic areas 4 and 6B comprised of Alcorn, Calhoun, Choctaw, Clarke, Itawamba, Jasper, Kemper, Lafayette, Lauderdale, Newton, Pontotoc, Prentiss, Tippah, Tishomingo, Union, Wayne, Webster, and Winston Counties.

incomes did not have an employment limitation. Employment opportunities of approximately 10,000 (53 percent) of the low-income families were limited by either age, physical handicap, or lack of formal schooling of the family head, or by the lack of an employable male member.

One-half, or about 3,500, of the full-time farmers with incomes under $1,000 and 7,500 of all farm families with incomes under $1,000 had less than 20 acres of cropland available. The small cropland acreage available and the low capital investment (less than $5,000) of these low-income farm families was reflected in their low level of labor utilization—less than 40 percent. As a group, families in which the head was 65 years of age or older had the lowest average net family money income of any age group. However, because these families were smaller, the average income per family member in this group differed little from those of families with family heads under 65 years of age.

INTRODUCTION

Not all farmers have been able to adopt the newly developed production practices and techniques designed to improve efficiency and increase income. Consequently, underemployed labor, low levels of overall resource efficiency, and hense, low incomes and living levels, characterize many rural areas. The low-income problem in these rural areas, however, is not restricted to farm families but appears to be a problem for the majority of the rural residents.

Considerable progress has been made during the last two decades in improving the per capita incomes of the Southern people. But the South's per capita income is still the lowest in the nation. The Clay-Hills Area of Mississippi, comprising 18 counties in the northeastern and east-central part of the state (census economic areas 4 and 6B) has for many years been characterized as a low-income area even in the low-income South.

The overall objective of the study reported was to ascertain and describe the sources and levels of income of rural families in the Clay-Hills Area in relation to the physical and human resources of these families. Specifically, this report presents data obtained from a field enumeration of randomly chosen open-country families on specified family characteristics, resource control and use, and sources and levels of family income. The report should be useful to persons working with the Rural Development Program and to others engaged in programs for improving economic conditions in rural areas.

MAJOR SOURCES OF INCOME

The rural families in the sample were classified into three major categories according to whether their primary source of income was farming, off-farm work, or nonwork. The number and percentage of families in each of the classes were:

Major source of income	Households	
	Number	Percentage
Farming	174	33.7
Off-farm work	197	38.1
Nonwork	146	28.2
Total	517	100.0

Income from farming included sales of crops, livestock, livestock products, timber, and income from work on other farms including custom work. Also included in farm income were Soil Bank payments. Off-farm work income was that amount earned by family members in nonfarm employment. Nonwork income arose from many sources, such as net rent on both agricultural and nonagricultural land, welfare payments, Social Security payments, retirement and pensions, and family support.

Overall, only 29.1 percent of the net income received by families in the study was derived from farming (Chart 1). Farming was the major source of income for only a third of the families in the study. Even within the farm group, income from farming constituted the major source of income for only about three-fifths of the families. The number of families wholly dependent upon agriculture for their livelihood was less, as only a fifth of all families and only about a third of the farm families were wholly dependent upon farming for their livelihood. It is obvious that, although the area is predominantly rural, a majority of the families, including the farm families, depend on income from sources other than farming for their livelihood.

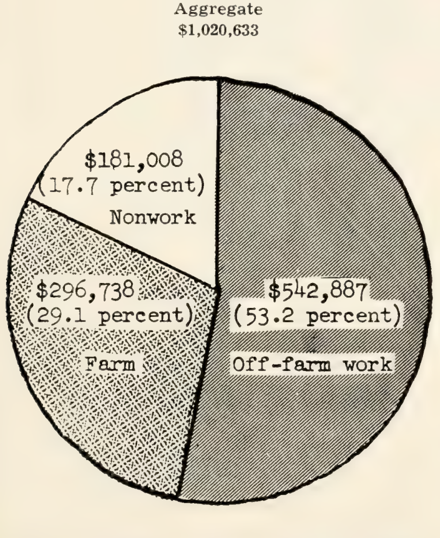

Chart 1. Aggregate income of 517 rural families by sources, Clay-Hills Area of Mississippi, 1958.

Off-farm Work as a Source of Income

In the aggregate, off-farm work income amounted to 53.2 percent of the net money income of families in the study. Another indication of the importance of off-farm work in the total income picture of these families is that earnings from off-farm work approximately equaled gross cash receipts from the sale of farm products. Off-farm work was the major source of income for nearly two-fifth of the sample families. It was the sole source of income for only about one family in six even though slightly more than a third of the family heads were engaged in off-farm work.

One in three of the farm families supplemented their farm incomes by having some family members performing off-farm work. About equal numbers of these families had either the head or other members of the family working off-farm.

Income from Nonwork Sources

In the total income picture of the families in the study, nonwork income was least important. Only 17.7 percent of the net money income of these families was derived from this source. However, nonwork income was received by two-fifths of the families. It was the major source of income for one in four families and the sole source for one in six families.

More families received income from nonwork sources than from any other source. A fourth of the farm families received nonwork income, and slightly more than half of these families received more income from nonwork sources than from farming.

In total, seven of every ten of the farm families received at least a part of their family income from off-farm work or nonwork sources. Even more striking is the fact that four of every five families in the study received at least some portion of their income from nonfarm sources.

SPECIFIED CHARACTERISTICS OF THE RURAL FAMILIES

The rural families included in the study varied as to race, age and education of the family head, type of family and other physical and social attributes. To some extent, these attributes are correlated with source and level of net money income.

Age Distribution

Persons 65 years of age and over made up 12 percent of the sample (Chart 2). When the two age groups, those 65 years of age and over and those under 14 years of age, are considered together as a dependency group, they make up about 40 percent of the sample. If the school and pre-school age groups (19 years and under) and the retired age group (65 years and over) are considered as a dependency group, then over 52 percent of the sample population is included.

Educational Levels of Rural Families

The educational level of family members affects type of employment open to them. The average level of formal education for all persons 14 years of age and over was 8 grades; however, the range was from no formal schooling to graduation from college. The educational levels of household heads and other family members over 14 years of age were:

Highest grade completed in school	Number of individuals: Household heads	Other family members	All
None	63	86	149
1-4	71	46	117
5-6	64	64	128
7-8	147	196	343
9-11	104	246	350
12	46	146	192
13 and over	22	55	77
Total	517	839	1356

Members of families in the off-farm work group had completed more years of formal schooling than members of either the farm families or the nonwork families. The relatively high educational level of the off-farm work families accounts, in part, for their being employed at other than farming; that is to say, because of their education they have been more able than other rural residents to compete for jobs in the local labor markets. The educational level of the heads of households employed off-farm was higher even for the group of nonfarm laborers than for the group employed primarily in agriculture. In the other occupational groups, the disparity between educational levels for farm and nonfarm family heads was even greater. The same generalizations are true for the other family members.

Family Types

Families were divided into groups according to age and sex of household head, but characteristics of other family members were also considered. The purpose of classifying the families in this manner was to gain some insight into their adjustment potentials in terms of family labor supply.

Slightly more than one-half of the families with household heads under 45 years of age and not occupationally handicapped were farm families, but these represented only about one-fourth of all farm families. On the other hand, three in five of off-farm employed families had household heads under 45 years of age and not occupationally handicapped. These data indicate that the younger, more aggressive heads of rural families had attempted to increase their incomes by obtaining off-farm employment.

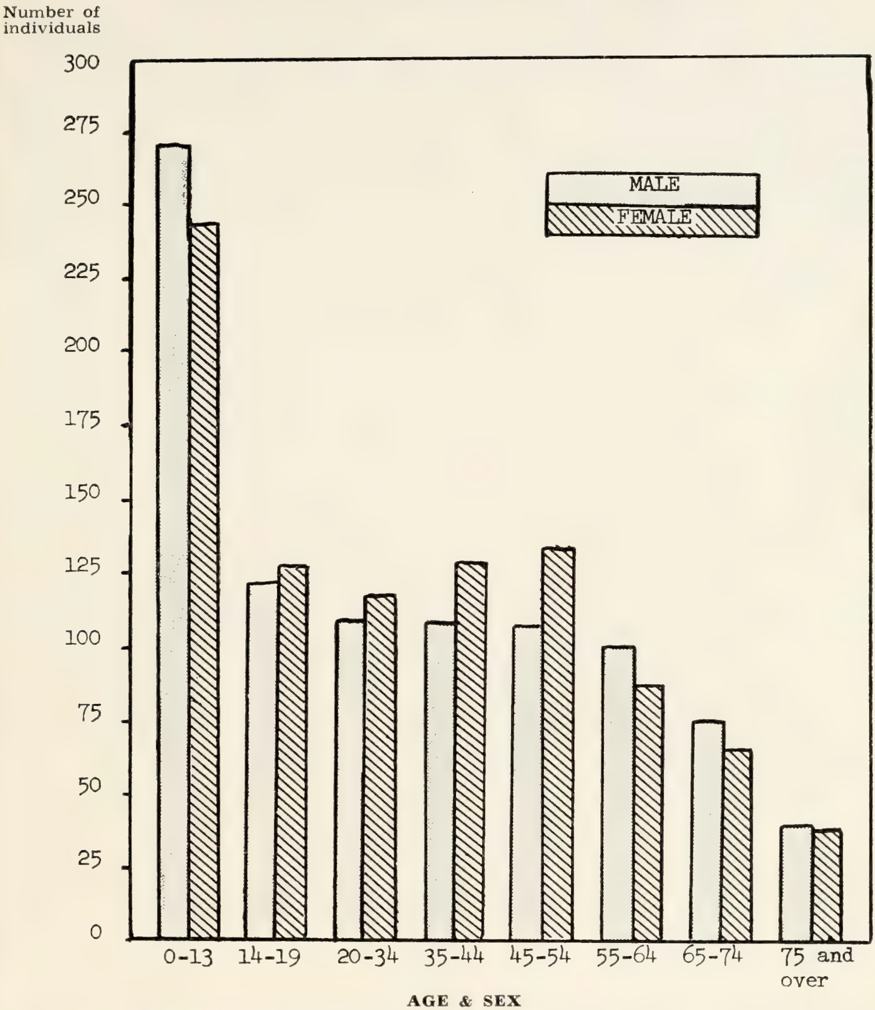

Chart 2. Distribution of population by age and sex, 517 rural families, Clay-Hills Area of Mississippi, 1958.

One-half of the farm families had heads between 45 and 64 years of age; in fact, over three-quarters of the rural families with heads between 45 and 64 years of age were farm families. From the relatively small number of farm family heads under 45 years of age compared with those between 45 and 64 years of age, it can be inferred that the replacement rate of farm families is low, and that a continued decline in the number of farm families in the area is to be expected.

In total, 28 percent of the families in the study were severly limited as to adjustment potential either within or outside agriculture because the head of the household was female or because the head was male but over 65 years of age. For the most part, these families depended upon nonwork income for their livelihood.

Family Characteristics and Income

One factor contributing to the low income situation in the Clay-Hills Area is the employment limitation faced by many families. Seven of every ten families in the study with net money income of less than $1,000 were so limited (Table 2). That is, these families had female household heads, or male heads who were either 65 years of age or older, had physical handicaps, or had relatively little education. Four of every ten families with net money incomes between $1,000 and $2,000 also were in the group with employment limitations. In all, more than half the families with net money incomes of less than $2,000 were subject to employment limitations severely affecting their adjustment potential.

Average total net money income of families with household heads under 65 years of age and without employment limitations was significantly higher than that of the handicapped group. Age of the household head and amount of net money income received by the family is significantly correlated; that is, the younger families tend to have higher net money incomes. One reason for this is that more of the younger than of the older family heads tended to work off-farm either part or full time.

The relationship between age and net money income is more clearly observable when only families without employment limitations are considered. For example, of the families with no outstanding employment limitations, nearly seven-tenths of those with heads under 45 years of age had net money incomes of more than $2,000, while only half of those with heads between 45 and 54 years of age, and a fourth of those with heads between 55 and 64 years of age, were in that income category.

A positive relationship also exists between the educational level of the family, particularly the family head, and the level of income. Over half the families with household heads who had had no formal schooling had net money incomes of less than $1,000. Almost half of all heads of families with net money incomes of less than $1,000 had had less than 5 years of formal schooling. On the other hand, four in five of those families with heads who had had seven or more years of formal schooling had net money incomes of $3,000 or more, and all families in this income class had some family member who had completed eight or more years of formal schooling.

Table 4. Distribution by level of income and family class, 517 rural families, Clay-Hills Area of Mississippi, 1958.

Family classification	Number of families	Levels of family net money income					
		Under $1000	$1000-$1999	$2000-$2999	$3000-$3999	$4000-$4999	$5000 and more
		Percent					
Total, farm	300	30.3	33.3	18.7	8.3	3.7	5.7
Full-time	106	49.1	36.8	9.4	1.9	—	2.8
Part-time:							
Head works off-farm	58	10.3	29.3	29.3	22.4	3.6	5.1
Others work off-farm	49	6.2	24.5	26.5	12.2	12.2	18.4
Nonwork income	87	34.5	36.8	18.4	4.6	3.4	2.3
Total, nonfarm	217	36.9	21.2	18.0	9.2	7.8	6.9
Off-farm work	109	5.5	20.2	30.3	17.4	13.8	12.8
Nonwork income:							
Welfare	73	76.7	17.8	4.1	1.4	—	—
Other	35	51.4	31.4	8.6	—	5.7	2.9
All rural families	517	33.1	28.2	18.4	8.7	5.4	6.2

CLASSIFICATION OF RURAL FAMILIES

Classifying the sample families by farm, off-farm work, and nonwork sources of income facilitates the determination of characteristics and the identification of the low-income families. Further classifying the families to reflect multiple income sources allows an even more precise identification of the rural families by income levels. The complete classification with a definition of each sub-class is as follows:

- **Farming** — Farm-operator families who received some portion of their income from their own farm operation.
  - **Full-time** — Farm-operator families who had little or no income other than from their own farm operation.
  - **Part-time** — Farm-operator families who received income from off-farm work.
    - **Head works off-farm** — The head of the household works off-farm either full or part time.
    - **Others work off-farm** — Family members other than the family head work off-farm either full or part time.
  - **Nonwork — Farm-operator families** who received income from welfare payments, retirements, and pensions including Social Security, and rental of either agricultural or nonagricultural real estate.
- **Off-farm work** — Rural families who received most of their income from the off-farm work of either the head of the household or other family members with no income from farming.
- **Nonwork** — Rural families who received no income from farming and most of their income from:
  - **Welfare** — Old age payments, aid to dependent children and family support.
  - **Other** — Retirements and pensions, payments including Social Security, rentals of either agricultural or nonagricultural real estate, and savings.

INCOME DISTRIBUTION

The low-income problem in the Clay-Hills Area is not altogether a farm problem, but it is a rural problem. The rural families in the study received their incomes from a variety of sources. Overall, 72 percent of the money income received by these families came from nonfarm sources (off-farm work and nonwork) and only 28 percent from farming, yet 300 of the 517 families were classified as farm families (Table 3).

Income of Farm Families

Farm families, on the average, received half their income from farming, 36 percent from off-farm work and the remaining 14 percent from nonwork sources. The 106 full-time farm families received little or no off-farm income. For all practical purposes, they depended entirely upon the farm for their livelihood. Nearly 86 percent of these families had net money incomes of less than $2,000, indicating that in general, the rural families depending wholly on agriculture for their livelihood are among the lowest income families (Table 4). The farmers with lower incomes had on the average a smaller acreage of the primary cash crop, cotton, and obtained lower yields per acre than the higher income farmers. Most of the full-time farmers were commercial farmers with gross cash farm sales between $1,200 and $2,400.

Part-time farm families averaged

receiving four-fifths of their income from off-farm work and slightly less than one-fifth from farming. On the whole, as the level of net money income achieved by the part-time farm family rose, a higher proportion came from nonfarm sources. Only about one in six of the part-time farmers had net money income from farming greater than $2,000.

The farm group in which family members other than the household head worked off-farm received the highest net money income of any group in the study. Farm earnings for this group about equaled the average farm earnings of the full-time farm group. The difference in income between the two groups is explained by the earnings from off-farm work of family members other than the head of the household. On the average, approximately two-thirds of the net money income of this group arose from off-farm work and the remaining one-third from farming.

The farm - and - nonwork income group of families received about one-half of their net money incomes from nonfarm, primarily nonwork, sources. Their total money incomes averaged more than those of the full-time farm group but less than those of the part-time groups.

Income of Rural Nonfarm Families

In general, families who depended on off-farm work for their livelihood received only a minor amount of income from other sources. Off-farm work was the only source of income for two-thirds of these families. In the majority of the families, it was the head of the household alone who worked off-farm.

The group of rural families depending primarily on nonwork income for their livelihood received income from two different sources — welfare payments and family support and retirement income and rents. Approximately 80 percent of the income of the group depending on welfare payment and family supports came from welfare and old age payments, aid to dependent children, and family contributions. The other group received almost two-thirds of their net money income from the renting out of agricultural land and from retirement benefits, including social security. As with all groups in the study, as income rose, an increasing proportion of the family net money income came from off-farm work.

RESOURCE USE

The Clay-Hills Area, in general, is characterized by small farms and low total investment per farm. Because of the low level of natural resources in the area, the relatively small operating units, and the low level of investment, widespread under-utilization of labor prevails.

Land Resources

The soils in the Clay Hills belong to the Upper Coastal Plain and the Thin Loess-Flatwood resource areas. These soils are made up largely of sand, clay, and gravel. They are low in plant nutrients, but in general they respond well to application of complete fertilizers and are easy to work. Many are well drained and suitable for most of the crops grown.

The average size of unit controlled by the rural families in the sample was 88 acres (Table 5). Nearly half of the 217 nonfarm families rented or owned two acres or less of land, and more than three-quarters controlled less than 10 acres; the remaining one-fifth had sizable land holdings and substantial investment in these holdings. The employment history of these nonfarm families with sizable land holdings indicates that almost without exception these families have until recently been part-time farmers.

Table 2. Characteristics of family head, by income levels, 517 rural households, Clay-Hills of Mississippi, 1958.

Income level	Number of families	Family heads with an employment limitation				Family heads without an employment limitation			Total
		65 years and over [1]	Physical handicaps [2]	Education less than 5 years	Female head	55 - 64 years of age	45 - 54 years of age	Under 45 years	
		— Percent —							
Less than $1,000	171	42	1	19	10	10	8	10	100
$1,000 - $1,999	146	19	1	14	5	19	21	21	100
$2,000 - $2,999	95	18	1	5	2	19	16	39	100
$3,000 - $3,999	45	13	—	4	4	11	26	42	100
$4,000 - $4,999	28	7	—	11	7	18	18	39	100
$5,000 and over	32	15	—	—	—	9	38	38	100
Total families	517	25.1	.8	12.4	6.0	14.5	16.8	24.4	100

[1] Includes all heads 65 and over — other groups are less than 65 and mutually exclusive.

[2] Includes only those household heads who had a physical handicap that would limit their employment in any job including farming.

Table 3. Proportion of income per family by family class, source of income, and income levels, 517 rural families, Clay-Hills Area of Mississippi, 1958.

Family net money income levels	All families				Nonfarm families				All farm families			
	Average income per family	Proportion of income by source			Average income per family	Proportion of income by source			Average income per family	Proportion of income by source		
		Farm	Off-farm work	Non-work		Farm	Off-farm work	Non-work		Farm	Off-farm work	Non-work
	Dols.	— Percent —			Dols.	— Percent —			Dols.	— Percent —		
Under $1,000	554	36	9	55	530	-2	11	91	574	67	7	26
$1,000 - $1,999	1,410	44	31	25	1,438	-1	57	44	1,396	65	19	16
$2,000 - $2,999	2,411	24	60	16	2,366	—	87	13	2,443	41	42	17
$3,000 - $3,999	3,434	16	76	8	3,399	[1]	93	7	3,462	28	62	10
$4,000 - $4,999	4,498	18	72	10	4,496	0	92	8	4,500	45	40	15
$5,000 and over	6,546	31	62	7	6,103	-1	90	11	6,937	55	41	4
Average all families	1,972	28	54	18	2,013	[1]	77	23	1,942	50	36	14
Number of families	517	xx	xx	xx	217	xx	xx	xx	300	xx	xx	xx

[1] Less than minus 0.5 percent.

Table 6. Number of farms, average acreage controlled, and average gross investment[1] per unit by class and income level, 300 farm families, Clay-Hills Area of Mississippi, 1958.

Net money income level	Full-time farm			Part-time farm						Farm and nonwork income		
				Head works off-farm			Others work off-farm					
	Number	Acres	Investment	Number	Acres	Investment	Number	Acres	Investment	Number	Acres	Investment
Less than $1,000	52	79	$ 5,112	6	19	$ 580	3	17	$ 8,195	30	55	$ 4,118
$1,000 - $1,999	39	98	9,506	17	69	5,661	12	112	5,574	32	62	6,080
$2,000 - $2,999	10	149	11,606	17	78	9,371	13	68	7,775	16	144	12,972
$3,000 - $3,999	2	198	27,328	13	91	11,783	6	136	10,794	4	213	19,036
$4,000 - $4,999	—	—	—	2	60	11,740	6	85	11,990	3	132	15,984
$5,000 or more	3	220	31,897	3	87	11,884	9	256	26,654	2	152	20,760
Total or average	106	99	$ 8,518	58	72	$ 8,127	49	130	$11,610	87	86	$ 7,934

[1] Includes investment in land and buildings, machinery and equipment, and livestock.

Table 5. Number of units, average acreage controlled, and average gross investment[1] per unit, by class and income level, 517 rural families, Clay-Hills Area of Mississippi, 1958.

Net money income level	Farm			Nonfarm with land holdings			Nonfarm with house and lot only [2]		All units with land holdings [2]		
	Number	Acres	Investment	Number	Acres	Investment	Number	Investment	Number	Acres	Investment
Less than $1,000	91	70	$ 4,576	37	76	$ 4,458	43	$ 605	128	72	$ 4,542
$1,000 - $1,999	100	83	7,283	25	65	5,143	21	702	125	80	6,356
$2,000 - $2,999	56	107	10,424	20	44	3,507	19	706	76	91	8,603
$3,000 - $3,999	25	130	13,952	12	90	9,226	8	616	37	117	12,419
$4,000 - $4,999	11	94	13,034	9	131	14,889	8	3,217	20	110	13,338
$5,000 or more	17	207	24,280	9	59	6,680	6	5,357	26	148	18,188
Total or average	300	95	$ 8,778	112	72	$ 5,969	105	$ 1,114	412	88	$ 8,014

[1] Includes investment in land and buildings, machinery and equipment, livestock, and nonfarm property.

[2] Less than 2 acres of land per unit. Average investment is for all nonfarm families with house and lot only. However, over half of the families, 56 in number, were renters.

Table 7. Estimated labor supply and utilization per family by family class, 517 rural households, Clay-Hills Area of Mississippi, 1958.

Family classification	No. of families	Average per family							
		Estimated family labor[1]	Off-farm employment of family	Seasonally hired farm labor	Total available farm labor	Farm labor requirements		Utilization of family labor	Utilization of available farm labor
						Crops[2]	Livestock[3]		
	No.	Hours						Percent	
Farm									
Full-time	106	4755	30	125	4850	1604	988	52.8	52.5
Part-time:									
Head works off-farm	58	4888	1812	105	3181	1006	683	70.3	53.4
Others work off-farm	49	5384	1429	300	4255	1380	1157	69.9	59.8
Nonwork income	87	3745	117	98	3726	889	772	46.5	44.8
Nonfarm									
Off-farm work	109	4389	2614	0	1775	11	77	61.3	4.3
Nonwork income:									
Welfare	73	1774	190	0	1584	6	86	17.1	7.1
Other	35	2286	280	0	2006	100	250	26.2	16.1
Total or average	517	3993	962	84	3115	732	564	54.2	41.3

[1] Based on the total number of hours of work an able-bodied male between 18 and 64 years of age could perform per year (exclusive of Sundays and holidays (3,120 hours). A few hours per year allowed for handicapped persons, those under 18 or over 65 years of age, and females.

[2] Based on hour labor requirements for each crop by acres, yield, and type and size of equipment used.

[3] Based on hour labor requirements per animal unit by type of enterprise.

The average size of farms in the sample was approximately 95 acres (Table 5), but the modal size was only 40 acres. Almost half the sample farms had less than 20 acres of cropland available and nearly three-fourths had less than 30 acres.

Full-time farmers generally had larger acreages of cropland available than the other farm groups (Table 6). A rather strong negative correlation appears to exist between acres of cropland available to the farm family and off-farm employment of family members. Regardless of tenure status, families that had relatively small acreages of cropland available to them were more prone than other farm families to have either the head of the household or other family members or both working off-farm. Slightly more than a third of the farm families with less than 20 acres of available cropland had some family member employed off-farm; nearly three-fourths had an outside source of income. Evidently, if the farm unit is not large enough to utilize the family labor supply and the family does not receive a substantial amount of nonwork income, the excess labor will seek gainful employment elsewhere. Approximately three in four of the farm families with one or more family members employed off-farm had less than 30 acres of available cropland.

Farm enlargement has progressed rather slowly in the area, even though over the years the number of farms has declined steadily. Aside from the usual credit limitations that hinder farm enlargement, there are a number of other obstacles that act as deterrents. The more important of these obstacles appear to be: (1) Sharp competition for land for sale because of the timber-production potential of the land, particularly in the Southern part of the area. There is widespread corporate owership of land throughout most of the area, and it is not unusual for farmers attempting farm enlargement through land purchase to be outbid by nonfarm buyers. (2) The hilly topography of the area which usually limits crop production to the valleys and stream bottoms. In order to increase even slightly the acres of cropland, therefore, it is usually necessary to purchase relatively large acreages of other lands. (3) The tradition of the English Estate system in which a hereditary estate may remain undivided through several generations or remain an estate until one of the heirs is able to buy out the remaining heirs. This system of land ownership reduces the amount of land for sale. And, (4) the tendency of many nonfarm rural residents who own sizable blocks of land to hold these lands. Most of them were formerly farmers and they hold on to their land just in case they lose their off-farm jobs, or with the idea that they will retire to these lands. Also, with the homestead tax exemption program, the cost of land ownership is quite low and the prospective return from timber sales is attractive.

Labor Resources

The way in which the family labor supply is used affects the income received by the family. Under-utilization of the labor supply usually results in a low family income. On the other hand, efficient utilization is associated with relatively high family incomes. The amount of labor available in the rural family is, among other things, a function of age, sex, and number of individuals. These factors also affect the efficient utilization of the family labor supply, as do level of education, physical handicaps, and the availability of profitable employment opportunities.

The group of active farm families had a larger labor force available

Table 8. Composition of family owned assets, total family debt and family net worth, 300 farm families, Clay-Hills Area of Mississippi, 1958.

Family classification	Total number of farm families	Value of owned assets: Land and bldgs.	Mach. and equip.	Live-stock	Non-farm	Total	Family debt[1]	Net worth[2]
		Dollars						
Farm	300	5,514	1,515	868	902	8,799	883	7,916
Full-time	106	5,080	1,835	972	634	8,521	1,071	7,450
Part-time:								
Head works off-farm	58	4,845	1,512	707	1,164	8,228	896	7,332
Others work off-farm	49	7,329	1,799	1,125	1,355	11,608	1,390	10,218
Nonwork income	87	5,468	967	705	797	7,937	358	7,579
		Percentage of total value of owned assets						
Farm		62.7	17.2	9.9	10.2	100.0	10.0	90.0
Full-time		59.6	21.5	11.4	7.5	100.0	12.6	87.4
Part-time:								
Head works off-farm		58.9	18.4	8.6	14.1	100.0	10.9	89.1
Others work off-farm		63.1	15.5	9.7	11.7	100.0	12.0	88.0
Nonwork income		68.9	12.2	8.9	10.0	100.0	4.5	95.5

[1] Includes both farm and nonfarm debts.

[2] Total value of owned assets minus total family debt.

than did the rural nonfarm families (Table 7). As the age of the household head and the major sources of family income are closely associated, the age of the family heads explains much of the difference in size of the labor force between the farm and nonfarm groups.

Only 60 of the 517 families studied fully utilized their labor. Thirty of these were headed by persons 65 years or older. However, in general, families with household heads 65 years of age and older had both a smaller labor force and a lower level of labor utilization than families in the other age groupings. Families in the middle age grouping (heads 35 to 64 years of age) generally had a larger labor force available, and utilized a smaller proportion of their labor supply than those families with household heads under 35 years of age. One explanation for these differences in degree of labor utilization is the high percentage of farmers and the relatively greater percentage of female household heads in the 35 to 64 years age group. A higher percentage of the household heads under 35 years of age worked off-farm and generally, as the off-farm employment of the family increased the degree of labor utilization increased.

Farm and Family Assets

Capital, both investment and operating, has traditionally been in short supply to the rural residents in the Clay-Hills Area. The farms in the area are generally small in size and relatively low in productivity. The average investment per farm in the sample was only $10,000. Over half of the full-time farm families owned assets of less than $5,000, and only about a fourth owned assets valued at more than $10,000. Actually, the true part-time farm families—that is, where the head of the household worked off the farm—owned on the average the smallest value of assets, and the farm families in which family members other than the household head worked off-farm owned the greatest value of assets.

Although there are some differences among the farm groups in value of assets owned, the relative composition of the assets owned showed little variation. In each group, land and buildings account for about three-fifths of the assets owned (Table 8).

Credit has not been extensively used by the farmers in the Clay-Hills Area. Approximately 70 percent of the farm operators indicated they had not used credit during the crop years 1955 through 1957. Of those farm operators who had used credit during these years, only 28 percent reported they borrowed money in each of the three years; another 39 percent re-

Table 9. Relationship between employment, investment and income, 300 farm and 109 off-farm employed families, Clay-Hills Area of Mississippi, 1958.

	Farm			Off-farm
	Full-time	Part-time		work
Item		Head works off-farm	Others work off-farm	
Estimated total employment (hrs.)	2,622	3,501	3,966	2,702
Net investment per unit (dol.)	7,887	7,064	10,253	2,846
Family net money income (dol.)	1,276	2,435	3,321	3,080
Interest on investment @ 5% (dol.)	394	353	513	142
Net money returns to labor (dol.)	882	2,082	2,808	2,938
Net money income per hour employed (dol.)	.34	.60	.71	1.09

ported borrowing in two of the three years. Slightly more than 85 percent of those receiving loans borrowed to cover current farm expenses and another 9 percent borrowed to cover both current farm expenses and family living. Only about 5 percent of the farm operators reported borrowing during this period to finance farm improvements. Nine of every ten farm operators did not think they could profitably use more credit.

Farm Assets, Employment, and Income

In general, as the acreage of cropland available to the farm family increased, the net money income received by the family increased. The tendency was for farm families with comparatively high levels of income to be owner-operators. For example, almost half the tenant farm operators had net money incomes of less than $1,000, whereas only about a fourth of the owner-operators had this low level of income. The relationship between family net money income, sources of income, and degree of utilization of the family labor supply was positive, for as the off-farm employment of the family increased the degree of labor utilization increased and higher net money incomes usually resulted. While the average degree of labor utilization for full-time farm and off-farm employed families was approximately the same, the off-farm employed families received on the average more than three times as much per hour employed as did the full-time farm families (Table 9).

For the most part, value of assets owned by farm families and the amount of net money income received increased together. Regardless of the income sources of farm families, as the acres of cropland increased the investment in farm power and equipment increased, the degree of labor utilization increased, and the net money income from farming increased. Almost without exception the

Table 10. Per capita net money income by age of household head, 517 rural families, Clay-Hills Area of Mississippi, 1958.

Per capita		Age of household head				
net money income	Families	Under 35	35-44	45-54	55-64	65-older
				Number		
Total	517	56	108	111	112	130
Less than $250	125	9	27	26	33	30
$250 - $499	149	11	31	35	25	47
$500 -$749	90	6	24	18	21	21
$750 - $999	53	10	14	8	11	10
$1000 - $1499	59	11	6	13	14	15
$1500 - $1999	23	6	4	5	4	4
$2000 and more	18	3	2	6	4	3
				Percent		
Total	100.0	100.0	100.0	100.0	100.0	100.0
Less than $250	24.2	16.1	25.0	23.4	29.5	23.1
$250 - $499	28.8	19.6	28.7	31.6	22.3	36.1
$500 - $749	17.4	10.7	22.2	16.2	18.7	16.2
$750 - $999	10.3	17.9	13.0	7.2	9.8	7.7
$1000 - $1499	11.4	19.6	5.5	11.7	12.5	11.5
$1500 - $1999	4.4	10.7	3.7	4.5	3.6	3.1
$2000 and more	3.5	5.4	1.9	5.4	3.6	2.3

Table 11. Per capita income and family class, 517 rural families, Clay-Hills Area of Mississippi, 1958.

Family classification	All families	Average family money income per capita					
		Under $500	$500-$749	$750-$999	$1,000-$1,499	$1.500-$1.999	$2,000 and over
	No.	Percent					
Farm	300	56.4	17.3	10.7	10.0	3.3	2.3
Full-time	106	79.3	12.3	3.8	2.8	0.9	0.9
Part-time:							
Head works off-farm	58	43.1	19.0	17.2	15.5	1.7	3.5
Others work off-farm	49	28.6	24.5	16.3	18.4	8.2	4.0
Nonwork income	87	52.9	18.4	11.5	10.3	4.6	2.3
Nonfarm	217	48.4	17.4	9.7	13.4	6.0	5.1
Off-farm work	109	24.8	18.3	15.6	22.0	10.1	9.2
Nonwork	108	72.2	16.7	3.7	4.6	1.9	0.9
Welfare	73	79.5	13.7	2.7	4.1	0.0	0.0
Other	35	57.1	22.9	5.7	5.7	5.7	2.9
Total	517	53.0	17.4	10.3	11.4	4.4	3.5

farmers with relatively large acreages of cropland and with relatively large net money incomes from farming used tractors or tractors and mules as the source of farm power. It cannot be inferred, however, that mechanization and a relatively large cropland acreage will assure a large net money income from farming—two-fifths of the farm families having tractors and more than 30 acres of cropland had net farm incomes of less than $1,000.

Per Capita Income

Rural families in which the head was 65 years of age or older had the lowest average net money income of any of the age groupings. Because of the relatively fewer individuals in these older families, the net money income per person was approximately the same as the per person income in the younger families (Table 10).

Approximately one-half of the farm families with per capita incomes of less than $500 operated full-time farms. In fact, almost 80 percent of the full-time farm families had per capita incomes under $500 (Table 11). Contrasted with this, only about one in every four off-farm employed families had per capita incomes under $500. The nonwork families generally had low per capita incomes, but not so low as those of the full-time farm families. The incidence of families with low net money income per capita is highest among the full-time farm families; but it is, nevertheless, a problem common to all groups of rural families.

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Climate of the Delta Area of Mississippi

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In Cooperation With
Delta Branch of the Mississippi Agricultural Experiment Station
and Delta Council
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Climate of the Delta Area of Mississippi

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Introduction

Ever since the beginning of agriculture, the most successful farmer has been the one who has the best understanding of the "calculated risk." In this day of scientific farming, many of the risks such as plant variety, diseases, insects, and weeds have very effective controls. Weather remains the biggest risk without control. The only way to deal with unfavorable weather is to anticipate and avoid it.

The nearness of the Gulf of Mexico, combined with a prevailing southerly wind, gives the Delta a mild, moist climate that is classified as semi-tropical. The yearly temperature averages 65° F., the annual precipitation 50.5 inches and the sun shines 61 percent of the daylight hours.

The location of the Delta and the weather averages quoted above give little hint of the great variability that occurs in this so-called stable climate. Every year is different and no set of agricultural procedures, designed to achieve the maximum benefit from the weather, will give the best result each year. However, through the years, the changes that occur in weather tend to appear at certain periods of the year. By studying long-term weather trends, the probability of success or failure of a weather-controlled operation can be determined. This paper is an attempt to make this information available for use in designing agricultural programs.

Precipitation

Yearly.—Annual precipitation in the Delta averages 50.5 inches, however, long-term records show that there has been great variation. Back in 1880, Vicksburg had over 84 inches of precipitation for the wettest year on record. In 1936, Yazoo City had a little less than 26 inches for the driest year on record. Even in recent times there have been years when total precipitation was far from the normal 50.5 inches. During 1957 and 1958, most of the Delta had over 70 inches in at least one of the years while Cleveland, Belzoni and Greenville had over 70 inches both years.

To understand weather and use this information in planning an efficient agricultural program, the planter must not only be familiar with average weather, but he must also know what are the chances of having "unaverage" weather. As a matter of fact, "average" weather is largely a myth and truly average weather seldom occurs in the Delta.

One of the simplest ways to consider a variable thing like rainfall and other weather elements is by way of probabilities. The first column in Table 1 shows the probability that the yearly precipitation in the Delta will be less than certain amounts.

The average precipitation, 50.5 inches, appears just to the right of the 50-percent probability figure. The driest year in 10 has 37.5 inches, this figure appears to the right of the 10-percent figure. This 10-percent reading means that a farmer who is willing to base his operation on having enough moisture nine years out of 10, would use 37.5 inches as an operational minimum. On the opposite end of the scale, the wettest year in 10 would have less than 64 inches (this figure appears to the right of the 90-percent probability).

During a period of 10 years, half of the years in the Delta normally have between 42.2 inches and 59.1 inches (to the right of the 25-percent and 75-percent readings). If total yearly precipitation above or below that range would require a special program, the farmer would suffer a loss during half of the years if he did not install the special program.

In planning a long-period operation, the figures to the right of the 5-percent and 95-percent probability readings indicate that yearly precipitation will be within the limits of 33.2 inches and 68.0 inches on 19 out of every 20 years.

For agricultural purposes, the variation of rainfall for the four seasons and the 12 months is of more importance than the variation in precipitation from year to year. The last four columns of Table 1 show the probabilities that seasonal precipitation will be less than certain amounts.

There is not much difference in average precipitation over the Delta. During the summer, rainfall tends to average a little higher in the south Delta and during parts of the winter and spring seasons, precipitation averages higher in the north Delta. The annual precipitation averages 2 to 4 percent higher in the south Delta than in the north. This variation in precipitation from north to south in the Delta, however, is very minor as compared with the variations that occur from year to year for the entire Delta as shown in Tables 1, 3, 5, 6 and 7.

Seasonal—The average seasonal precipitation is shown in Table 1 to the right of the 50-percent probability. During winter and spring, seasonal precipitation averages about 14 inches, during summer, about 10 inches and in fall about 9 inches. The driest period expected on the order of one out of 10, gives a winter precipitation of 8 inches or less, spring 9 inches and summer and fall 4.5 inches. Similarly for the wettest period in 10 years, precipitation is expected to average less than 22 inches in winter, 21 inches in spring and 16 inches in either summer or fall.

Rainfall during spring (March, April and May) averages about 14 inches, a very desirable amount, if the 14 inches are spread over the season properly. It is very rare that spring is too dry to give a good stand of cotton in the Delta; however, it is rather frequent that the crop has too much rain and is either drowned out or suffers from diseases due to cool, damp weather. As indicated above, the driest spring in 10 years has less than 9 inches. Even with only 8 or 9 inches of rainfall, crops do not suffer much if the rain is spread out through the spring. On the other end of the scale, rainfall averages as high as 21 inches one year out of 10; and this is definitely too wet for agriculture. This type of very wet weather occurred in 1958 when the average spring rain in the Delta was about 20 inches and crops got off to a poor start that year.

In the summer season, the lack of rain is often a limiting factor as plants stop growing for the lack of water. On rare occasions, excessive summer rainfall is detrimental to crops by promoting insects and diseases and in local areas by mechanical injury to the plants, such as flooding and breaking stalks.

Fall is normally the driest of the three major growing seasons in the Delta, but even so, some falls are so wet that crops suffer. Prolonged wet weather in the fall, not only slows the harvest by making fields too wet to work, but wet weather can prolong leaf growth so long that maturity is delayed and crops are caught by freezing temperatures. Wet weather also affects the crops directly in the fall, especially cotton, by lowering the quality and causing boll rot. Dry fall weather is good cotton weather.

In Table 1, the fall rainfall to the right of the 95-percent probability calls for amounts as much as 19 inches on the order of once in 20 years. Even these very unlikely amounts do occur, and a look at 1958 shows that they have occurred, and have even been exceeded in recent years, as well as many years back.

The fall of 1958 produced almost 25 inches of rain at Greenwood which was the greatest fall total in their 65 years of record. On the year before, over 22 inches of rain was measured at Greenwood, which was the fourth greatest rainfall in the 65-year record. Clarksdale has rainfall records that go back

Table 1. Probability that yearly and seasonal precipitation will be less than certain amounts.

Probability	Year	Winter	Spring	Summer	Fall
95	68.0	24.0	22.2	17.3	19.0
90	63.8	22.0	21.0	16.0	16.0
80	60.8	19.2	19.1	14.1	13.5
75	59.1	18.1	18.1	13.6	12.8
70	57.5	17.8	17.0	13.0	11.8
60	53.8	16.0	15.7	11.8	10.0
50	50.5	14.2	14.1	10.0	8.5
40	48.0	13.4	13.4	8.8	8.0
30	45.5	12.2	12.5	7.6	7.2
25	42.2	11.3	11.7	6.8	6.5
20	38.9	10.4	10.7	5.9	6.0
10	37.5	8.1	9.0	4.5	4.5
5	33.2	7.1	7.4	3.5	3.5

Table 2. Extremes in yearly precipitation for all stations for all years of record. Extremes in seasonal precipitation for Clarksdale, Greenville, Greenwood and Yazoo City for 25-year period of 1934-1958.

Precipitation extreme		Year	Winter	Spring	Summer	Fall
Greatest	Amount	84.22	26.79	29.05	24.74	24.36
	Year	1880	1939	1953	1940	1958
	Location	Vicksburg	Greenville	Clarksdale	Greenwood	Greenwood
Least	Amount	25.97	6.54	6.09	3.24	1.99
	Year	1936	1943	1936	1954	1953
	Location	Yazoo City	Greenville	Yazoo City	Greenville	Yazoo City

52 years and the fall of 1957 with 23 inches of rain was the wettest in the entire 52-year period. Greenville has had records of rainfall for 70 years and the fall of 1957 was the second wettest of that period while the fall of 1958 was the fifth wettest during the 70-year period.

The probability figures used throughout this pamphlet do not take into account the rare type of extreme weather that occurred during the very unusual falls of 1957 and 1958, but they can be used to determine the chances of occurrence of different weather elements on the basis of one time out of 10 (the 10-percent and 90-percent probabilities) or other prescribed time limits.

Table 2 shows the extreme, or record, precipitation totals for the seasons of the year. The wettest season in recent years was the spring of 1953 when nearly 30 inches of rain was measured at Clarksdale, the driest season occurred the same year during the fall when Yazoo City had less than 2 inches of rain. If all of these seasonal records had occurred during one year and at one point, the wettest year would have had 105 inches and the driest, less than 18 inches. This, of course, is an extremely unlikely event and is shown only as a remote possibility of what could happen.

Monthly.—There is a considerable difference in average precipitation during the different months. Table 3 shows that the wettest month is normally March with over 5 inches of rain and driest month is October with less than 2 inches. On the basis of the driest year in 20, it can be seen on the

Table 3. Probability that monthly precipitation will be less than certain amounts.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	12.1	10.0	9.7	10.0	9.2	7.8	7.5	5.8	5.8	6.2	10.7	8.0
90	10.8	9.0	8.9	8.9	7.8	7.0	6.1	4.8	5.1	5.4	9.5	7.1
80	8.6	7.5	7.7	7.2	6.0	5.8	5.6	3.8	3.9	3.6	6.5	6.0
75	8.0	6.9	7.2	6.7	5.6	5.3	5.2	3.5	3.5	3.2	5.6	5.7
70	7.1	6.3	6.6	6.2	5.1	5.0	4.9	3.1	3.1	2.8	5.2	5.2
60	5.1	5.1	5.9	5.4	4.6	4.5	4.1	2.6	2.6	2.0	4.2	4.5
50	4.2	4.2	5.4	4.8	4.0	3.6	3.3	2.3	2.3	1.7	3.7	4.1
40	3.8	3.5	5.0	4.2	3.3	3.2	2.9	2.0	2.0	1.3	3.4	3.7
30	3.3	2.9	4.7	3.6	2.5	2.7	2.5	1.5	1.6	1.1	3.1	3.2
25	3.1	2.7	4.4	3.2	2.1	2.4	1.8	1.1	1.3	0.9	2.7	3.0
20	2.6	2.5	4.1	2.8	1.7	1.9	1.5	1.0	1.1	0.7	2.5	2.7
10	2.2	2.1	3.2	1.9	1.0	1.2	0.8	0.5	0.6	0.4	1.5	1.8
5	1.6	1.8	2.4	1.5	0.7	0.7	0.5	0.3	0.4	0.2	0.8	1.2

5-percent row that March would be expected to have a little less than 2.4 inches, while October would have less than 0.2 inches.

In spring, the steady decrease in average amounts of rainfall is important—March, 5.4 inches; April, 4.8 inches and May, 4.0 inches. It is even more important that the low end of the scale be considered. During March, the driest year in 10 has somewhat less than 3.2 inches of rain, while in May the driest year has less than 1.0 inch. In March, it might be said that the weather is never too dry to insure germination of seed; however, it is often too wet. In May, it is often too dry and sometimes too wet. April is the best median. The odds are 7 out of 10 that rainfall during April will be between 2 and 7 inches, just about the right amount to get plants up and off to a good start.

During the summer months, rainfall averages continue to drop. June rainfall averages around 3.6 inches, July 3.3 inches and August rainfall about 2.3 inches. The lack of rain is more detrimental to crops in summertime than is the excess of rain.

The consistent drop in monthly average rainfall that began in April continues into October, which is the driest month. The normal rainfall for the fall months is: September 2.3 inches, October 1.7 inches and November 3.7 inches. About twice as much rain falls in November as in October, while September is only a little wetter than October. The row of rainfall figures to the right of the 75-percent reading show 3.5 inches for September, 3.2 inches for October and 5.6 inches for November. This would usually mean that 3 out of 4 years would be passable for cotton picking in September and October but not in November. These figures point to the desirability of designing harvest programs for September and October, rather than November.

Table 4 shows the greatest and least monthly rainfall reported by Clarksdale, Greenville, Greenwood and Yazoo City for the 25-year period 1934-1958. If the record maximum months were added together, yearly precipitation would total the incredible amount of 150 inches while the record dry months would yield less than 7 inches.

Total precipitation for yearly, seasonal and monthly periods does not give the complete answer to "How wet is the weather?"; however, it is the best single estimate in humid regions such as the Delta. For a period of a month or longer, it is sometimes hard to say whether the predominate weather pattern is wet or dry. On any one of the days the weather is either wet or dry depending on whether rain falls. By contrast, whether the weather is wet or dry for a period of a month or longer depends on many things The total amount of rain, how much of the time rain falls, how much sunshine there is, the average humidity and the strength of the wind.

Table 5 is one of the additional measures of "How wet is the weather?" and

Table 4. Extreme monthly precipitation for Clarksdale, Greenville, Greenwood and Yazoo City for 25-year period 1934-1958.

		Month					
		Jan.	Feb.	March	April	May	June
Greatest	Amount	15.40	11.63	10.13	12.02	14.27	11.19
	Year	1939	1956	1944	1940	1953	1947
	Location	Greenville	Yazoo City	Greenwood	Greenville	Clarksdale	Greenwood
Least	Amount	1.37	0.97	1.32	1.18	.36	0
	Year	1942	1943	1954	1943	1951	1952
	Location	Greenville	Greenwood	Clarksdale	Greenville	Yazoo City	Greenwood
		July	Aug.	Sept.	Oct.	Nov.	Dec.
Greatest	Amount	10.47	9.21	19.65	9.82	15.43	10.24
	Year	1940	1934	1958	1941	1948	1951
	Location	Greenwood	Greenwood	Greenwood	Clarksdale	Greenwood	Greenwood
Least	Amount	.43	0	.06	0	.11	.80
	Year	1954	1935	1953	1952	1949	1958
	Location	Greenville	Greenwood	Yazoo City	Greenwood	Greenwood	Greenville

shows the probability that the number of days with 0.01 inches of precipitation will be less than certain amounts. The number of rainy days indicated in the table closely parallels the monthly total precipitation shown in Table 3. October is the driest month. The title of wettest month by this category is shared by March and December.

For purposes of planning field work during the growing season, Table 5 indicates the same conclusion as Table 3. The spring months show a drop in the average number of rainy days per month from 10 in March to 8 in May. In the fall, rain normally falls on 5 days in September, 4 days in October and 7 days in November. November shows the greatest percentage difference from wet to dry weather; in the driest year in 20, rain falls on only one day in November; while in the wettest year in 20, rain falls on 13 days. This indicates that there are a few very dry Novembers, but most of them are wet in comparison with September and October. A similarity exists in the opposite direction when May is compared with March and April. That is, during months with normal or subnormal rainfall, May is considerably drier than March and April, but during the one out of four wet years, there is not much difference in number of rainy days in May as compared with March and April.

Table 5 shows another rather interesting feature, even on the driest period in 20 years, precipitation is practically assured on at least one day during each month. Conversely, the wettest period in 20 years usually has at least 10 days a month on which rain does not fall.

One-day Heavy Rains.—Rainfall rarely, if ever, occurs evenly distributed throughout the month. Table 6 shows the probability that the heaviest one-day rainfall for each month will be less than certain amounts. Table 7 shows the same information for the heaviest 4-day rain.

Table 6, the heaviest one-day rainfall gives a measure of the flash flood threat in the Delta. On the basis of the heaviest one-day rain for one month for 20 years, it can be seen that all months are subject to near 3-inch rains. December is the month most likely to have a heavy one-day downpour with the odds of one out of 20 showing 4.2 inches, and April is next with 4.1 inches.

These heavy one-day rains shown in the top part of the April column, indicate the occurrence of "hard packing" rains which constitute one of the big hazards of getting a stand of cotton. It is rather strange that the heaviest one-day rain (on the order of once in ten years) occurs in April instead of March; as this distribution would con-

Table 5. Probability that the number of days with 0.01 inches of precipitation will be less than certain amounts.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	19	17	14	13	13	14	14	12	12	12	13	14
90	16	15	12	12	11	13	13	11	10	10	11	13
75	13	11	11	11	10	11	9	8	7	7	9	11
50	10	9	10	9	8	8	8	6	5	4	7	9
25	8	7	8	7	6	5	5	4	4	3	5	7
10	6	4	6	6	3	3	4	3	3	2	3	5
5	4	3	5	5	2	2	3	2	2	1	1	4

Table 6. Probability that the heaviest one-day rainfall occurring each month will be less than certain amounts.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	4.20	3.20	3.40	4.10	3.00	3.30	3.10	2.90	3.00	2.80	3.70	3.00
90	3.30	2.75	2.80	3.50	2.70	2.80	2.80	2.40	2.10	1.90	3.00	2.50
75	2.10	2.00	2.20	2.20	2.10	1.80	2.00	1.80	1.60	1.40	2.25	1.85
50	1.60	1.50	1.75	1.60	1.25	1.30	1.40	1.10	1.05	.85	1.70	1.40
25	1.10	1.10	1.20	1.20	.80	.80	.80	.50	.65	.45	1.10	1.00
10	.75	.80	.95	.65	.50	.50	.50	.30	.30	.25	.75	.70
5	.65	.70	.80	.55	.35	.20	.30	.10	.10	.10	.50	.40

form to the other rainfall distributions shown in Tables 3, 5 and 7. This threat probably precedes the vigorous late season cold air outbreaks that normally do not penetrate this far south, but on the rare occasion when they do, they give extreme weather.

The heaviest one-day rain expected under the 50-percent probability, has a distribution similar to Tables 3 and 5; March is the wettest with 1.75 inches and October is the driest with 0.85 inches. The contrast between October, with less than an inch, and November, with 1.70 inches, is again indicative of the better harvesting weather in October than in November.

Four-day Heavy Rains.—Table 7, showing the heaviest 4-day rain is indicative of local flooding which lasts a little longer than a flash flood but is still much more local in nature than the major river floods resulting from up-stream run off. The top row of figures, which show the heaviest 4-day rain expected on the order of one in 20 years give the heaviest rains from November through April with an isolated peak in July.

The greatest 4-day rains in winter and March occur with slow moving, well developed low pressure systems. In November, the heavy rains reflect the infrequent but very heavy rains of tropical disturbances that move inland. During July, the peak occurs when a number of thundershowers occur over the same spot on several days in succession.

In the spring peak, it is interesting to note that the heaviest 4-day rains occur in March instead of April, thus conforming to the monthly precipitation pattern.

The 50-percent probability of heavy 4-day rains has a maximum in March and April with 2.3 inches, followed by November with 2.2 inches and July with 2.1 inches.

During the summer and fall, it has been found that the heaviest 4-day rain usually includes about half of the total month's rain. This gives an indication of just how dry some of these months become. For example, during the months of August, September and October, the heaviest 4-day rain on an average year has less than one and a half inches. Thus, for the other 26 or 27 days, the daily rainfall could not average over 0.05 inches, and this would not have much effect in wetting the soil.

Daily Spring Rainfall.—Figure 1 shows the probability of certain small amounts of rain during March, April and May. These amounts are about the necessary rainfall to give germination. They vary from 0.15 inches in March to 0.20 in April and 0.25 in May, which is proportional to the variation in evaporation. By starting on the left-hand side of Figure 2 at the 50-percent probability level and going straight across to the March curve and then straight down to the bottom line; you find there is a 50-50 chance of getting enough rain to germinate the seed in March on the 2nd day after planting following two days of dry weather. In April, the same conditions apply to the 3rd day and in May the 5th day. During May, there is a 3 out of 10 chance of not getting enough rain for germination by the 10th day after planting, and this situation might cause the loss of some seed. This contingency can be controlled somewhat by planting with fairly high soil moisture.

Table 7. Probability that the heaviest four-day rainfall occurring each month will be less than certain amounts.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	5.80	5.40	6.00	5.70	4.40	4.50	5.50	4.00	4.50	4.00	6.00	4.20
90	4.80	4.40	4.70	4.60	3.90	3.60	4.40	3.00	2.90	2.50	4.50	3.50
75	3.70	3.05	3.30	3.10	3.10	2.70	2.90	2.10	2.00	1.75	3.10	2.80
50	2.05	2.00	2.30	2.30	1.85	1.90	2.10	1.40	1.40	1.10	2.20	2.20
25	1.40	1.35	1.80	1.50	1.00	1.10	1.20	.80	.75	.65	1.60	1.40
10	1.10	1.10	1.35	.90	.60	.65	.70	.35	.35	.30	1.00	.90
5	.85	1.00	1.00	.70	.45	.30	.50	.20	.20	.15	.50	.60

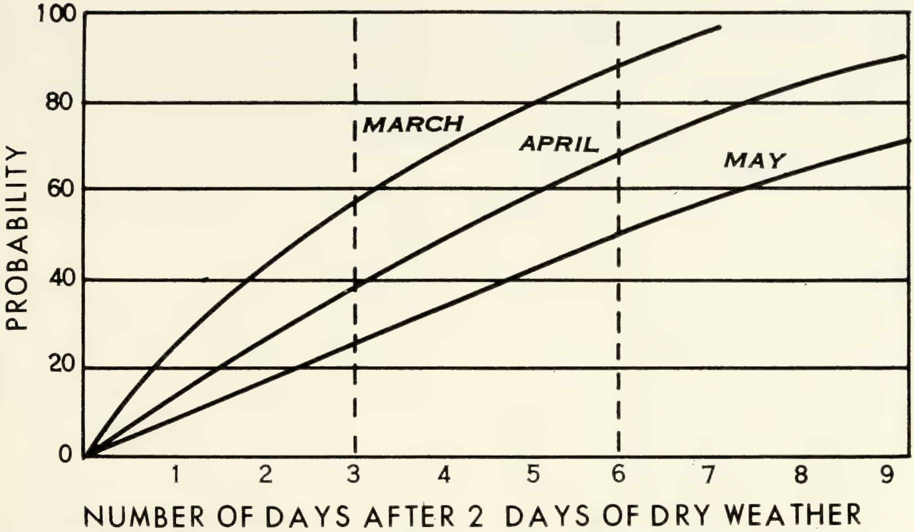


Figure 1. Probability that at least a certain minimum amount of rain (March, 0.15 inch; April, 0.20 inch; May, 0.25 inch) will follow two days of dry weather.

On the other end of the scale, rain is so likely in March that the seedlings are likely to be drowned out, or the very damp weather may favor seedling diseases that will kill or stunt the plants.

Figure 2 shows the possibility of heavier amounts of rain following a 2-day dry period. On a 50-50 basis, heavy rains will not affect the crop either in March, April or May. But using the odds of 3 years out of every 10, excessive rainfall will accumulate by the 3rd day after planting in March and on the 4th day after planting in April. The excessive rainfall will not accumulate until the 6th day after planting in May and it is very unlikely that it would harm the crop. Again the month of April is the best balance be-

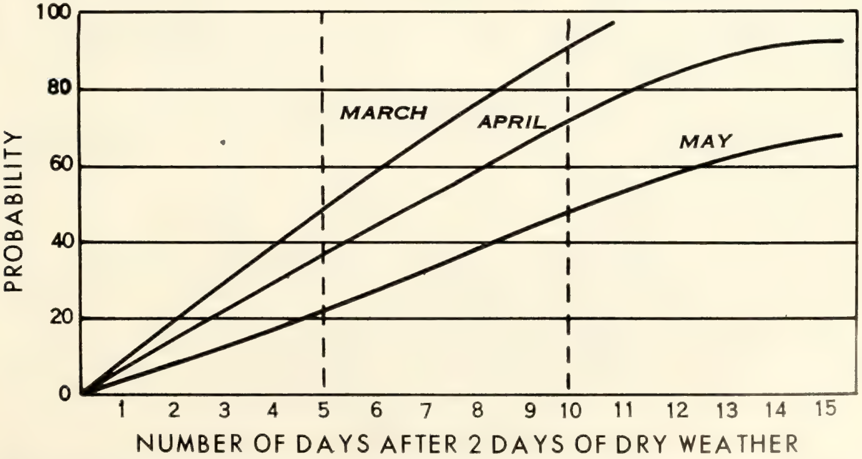
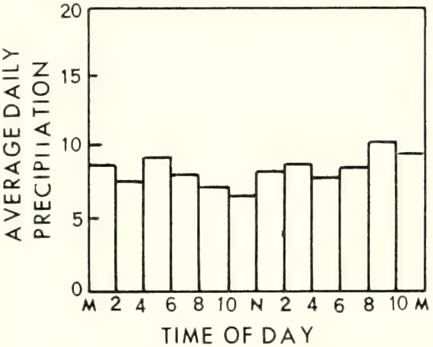


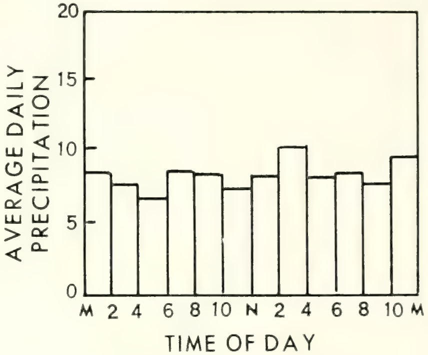
Figure 2. Probability that at least a certain minimum amount of rain (March, 0.6 inch; April, 0.8 inch; May, 1.0 inch) will follow two days of dry weather.

tween enough rain to germinate seed and too much rain that would either drown the crop or bring on seedling diseases.

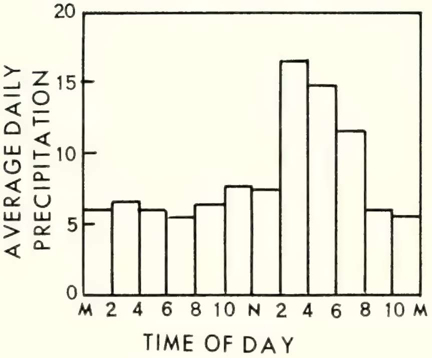
Hourly Rainfall.—In addition to the variability of precipitation between years, season, months and daily periods, certain hours of the day are more likely to have rain than other times. Figure 3 shows the average precipitation for the



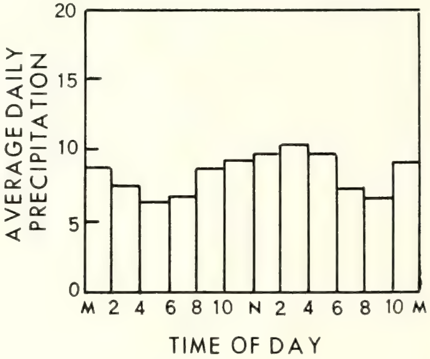
WINTER Dec - Feb



SPRING March - May



SUMMER June - Aug



FALL Sept - Nov

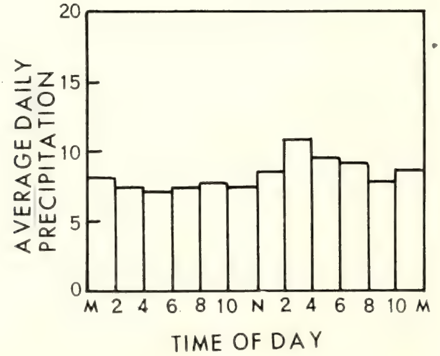


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Figure 3. Average precipitation for two-hour interval throughout the day.

Delta based on records for Memphis 1950-58 and Vicksburg 1952-58 for 2-hourly periods. The peak for the year is 3 p.m. or the 2-hour interval from 2 p.m. to 4 p.m. The smallest amount of precipitation falls during the period of 4 a.m. to 6 a.m. The precipitation for the 2-hour afternoon peak period was one and a half times the amount of the morning minimum.

During the summer, a strong rainfall maximum occurs in the afternoon, in fact, rainfall during the period of 2 p.m. to 4 p.m. is over three times the amount that occurs from 6 a.m. to 8 a.m. During the winter, the hourly variation is not as pronounced. In winter there is a peak from 8 p.m. to 10 p.m. and a smaller peak from 4 a.m. to 6 a.m. with a minimum from 10 a.m. to noon. During the summer, the strong peak occurs in the afternoon due to the strong heating of the ground that takes place at that time which tends to make thundershowers more numerous and give heavier rainfall amounts. This afternoon peak is visible to a lesser extent in spring and fall but is about wiped out in winter. The tendency for the peak to be delayed in other than summer months is due in part to the fact that thunderstorms develop in the warmer southwest part of the country (in Louisiana, Arkansas and Texas) in the afternoon hours and then drift across the Delta with the prevailing west to southwest winds aloft. A number of other effects enter in to make winter hourly rainfall distribution quite different from the summer distribution.

In the summer, most precipitation occurs in the form of showers, in the fall and winter there are frequent periods of drizzle or very light rain that do not add up to the heavier amounts typical of summer showers. Figure 4 shows the hourly probability of precipitation for the fall months. The transition from a summer type peak in the afternoon during September to a peak in the morning during November is rather outstanding.

This distribution is of importance in considering fall harvesting programs. Aside from the fact that rain is least frequent in October and most frequent in November, the timing is important.

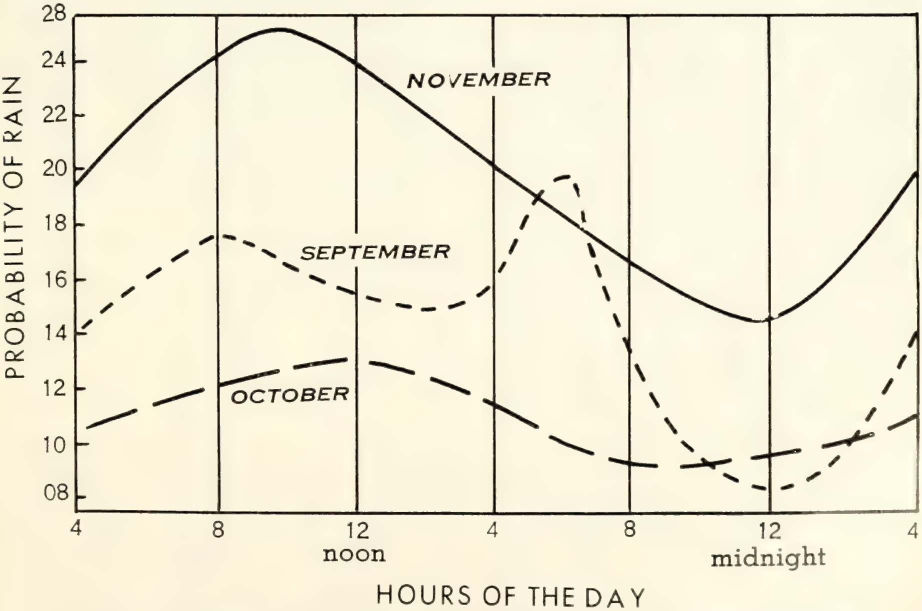

Figure 4. Probability that rain will fall during each hourly period of the day.

In September, rain is most frequent in the evening about 6 p.m. This results from showers that are started by the maximum heating in the afternoon. A second maximum occurs in the morning at 8 a.m. in September and this is usually a result of early morning drizzle that clears out late in the morning. Thus in September, if rain has not fallen in the morning, there is usually a good chance of getting quite a bit of field work done before the late afternoon showers begin. Also, if there is a drizzle or mist in the morning, as occasionally is the case, many fields would dry in the afternoon due to the relatively longer days that occur early in the fall.

October has a single and rather weak maximum of rain and that is around noon. November has a maximum of rain about 10 a.m. This often is just a drizzle from low hanging clouds, but it usually wets the cotton enough that it should not be picked that day.

Temperature

Temperature variations is much different than rainfall variation in the Delta. Variation from year to year in temperature is very slight, but variation from winter to summer is considerable. Table 10 shows that the yearly temperature averages 65 degrees. On only 5 percent of the years does the temperature average less than 62 degrees and only 5 percent of the years average over 66.5 degrees. Thus, 90 percent of the years have an annual temperature range of less than 5 degrees.

Monthly.—Table 8 shows the average maximum and Table 9 the average minimum temperatures by months stated in terms of probability. The coldest month is January with an average maximum of 56.5 degrees and an average minimum of 36.5 degrees. The warmest month is July with an average maximum of 93.5 and an average minimum of 72.0. The difference in mean temperature between the two extreme months is just slightly over 36 degrees. The difference is much greater than the difference in seasonal precipitation; however, by comparison with northern states, the seasonal temperature variation is quite small. Temperature differences from north to south in the Delta amount to 2 or 3 degrees during the cool season and even less in the summer. By comparison with the differences shown in Tables 8, 9 and 10, north to south variation is very small.

Average monthly maximum temperatures take their biggest rise from March to April (a rise of 9 degrees) and their biggest drop from October to November (a fall of 14 degrees). Average monthly minimum temperatures follow the same pattern, a rise of 9.5 degrees

Table 8. Probability that monthly maximum temperature will be less than certain readings.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	62.5	65.5	76.5	80.0	87.5	97.0	98.0	99.0	94.0	84.0	70.0	63.0
90	61.5	64.0	74.5	79.0	87.0	96.0	97.0	98.0	93.0	83.0	69.5	62.0
75	59.5	62.5	70.5	78.0	86.0	93.0	95.0	96.0	90.5	82.0	67.5	60.5
50	56.5	59.5	67.0	76.0	84.0	91.0	93.5	93.5	88.0	79.5	65.5	57.5
25	53.0	55.0	63.5	73.5	82.5	89.0	91.0	91.0	85.5	76.5	64.0	56.5
10	48.5	52.5	60.5	72.5	80.0	87.5	89.5	90.0	83.5	74.5	62.0	51.0
5	45.0	51.0	59.0	72.0	78.5	87.0	89.0	89.5	82.0	73.0	60.0	50.0

Table 9. Probability that monthly minimum temperatures will be less than certain readings.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	43.5	44.5	52.5	57.0	65.0	73.0	74.0	73.5	68.5	59.0	47.5	41.5
90	42.0	43.5	51.5	56.5	64.0	72.0	73.5	73.0	67.0	57.5	46.5	41.0
75	39.0	41.5	47.5	55.0	63.0	70.5	73.0	72.5	65.5	55.0	44.0	39.5
50	36.5	38.5	44.0	53.5	61.5	69.5	72.0	71.0	63.5	52.5	41.0	37.0
25	33.0	35.5	41.5	51.0	60.0	68.0	70.5	69.5	61.5	50.5	39.5	34.0
10	28.0	30.5	39.5	49.5	58.0	66.5	70.0	68.5	60.5	48.0	38.0	32.0
5	24.5	29.0	38.5	49.0	57.5	66.0	69.0	68.0	59.5	43.5	37.0	30.5

from March to April and a fall of 11.5 degrees from October to November.

The variation of temperature from year to year for the individual months is much greater in winter than in summer. The difference between the 95-percent probability and the 5-percent probability gives the range of monthly temperatures for 9 out of 10 years. During January this range of monthly maximum temperatures is 17.5 degrees and for minimum temperatures 19.0 degrees. By contrast in July, maximum temperatures have a range of 9.0 degrees and a minimum temperature a range of 5.0 degrees. March and October have large ranges in average monthly temperature, which combined with the large change in average temperature that follows these months, points to the fact that March and October are pivot months. March usually marks the end of winter in the Delta while October usually marks the end of summer.

A commonly quoted law of chemical reaction states that chemical actions take place twice as fast for each increase of 18 degrees temperature. This also holds true for most plants near the growing range of temperatures. For this reason, the large temperature changes that take place in March and October precede the beginning and ending of the growing season.

Freezing Temperatures.—While temperature variation discussed above affects the rate of plant growth, temperatures as low as the freezing point stop growth of many plants entirely by killing the plant. Early spring plantings are killed by frost or freezing temperatures from time to time. Knowing the average date of the last freeze is helpful; however, an understanding of the odds of the last spring freeze occurring either before or after the average date offers more real help in avoiding this threat.

Table 11 shows the probability that certain minimum temperatures will occur on or after particular dates in the spring. The dates in the table apply to the central Delta with about a 3- to 4-day delay in the north Delta and about a 3- or 4-day earlier occurrence in the south Delta. The average date of the last 32-degree temperature conforms fairly closely to the average date of the last killing frost, however, light frosts occur about a week or 10 days later. The average date of the last 32-degree temperature is March 16th, this means that cotton seedling will be killed every other year if they are up on March 16th. For a long-term farming operation, a 50-50 chance of having to replant is rather unprofitable. By using more favorable odds, a more profitable date can be obtained. The chance of a freeze occurring as late as the 5th of April is 1 out of 10, which means that replanting will be necessary from freezing temperatures on 1 out of every 10 years. A freeze would necessitate replanting on 2 out of every 10 years if the seedling are up on the 28th of March; on 3 out of every 10 years on March 24th; and on 4 out of every 10 years on March 20th.

The temperatures listed to the right of the 32-degree column of Table 11 are for more hardy vegetation. The 50-50 chance of a temperature down to 24 degrees ends about February 10, while a temperature of 16 degrees is so

Table 10. Probability that the yearly mean temperature will be less than certain readings.

95	90	75	50	25	10	5
66.5	66.0	65.5	65.0	64.0	63.0	62.0

Table 11. Probability that certain minimum temperatures will occur on or after particular dates in the spring.

	Temperature				
Probability	32°	28°	24°	20°	16°
10	April 3	March 23	March 12	Feb. 28	Feb. 16
25	March 25	March 12	Feb. 26	Feb. 9	Jan. 22
50	March 16	Feb. 28	Feb. 7	Jan. 20	——
75	March 8	Feb. 16	Jan. 22	——	——
90	Feb. 22	Jan. 31	——	——	——

Table 12. Probability that certain low temperatures will occur on or before particular dates.

	Temperature				
Probability	32°	28°	24°	20°	16°
10	Oct. 19	Nov. 1	Nov. 6	Nov. 16	Dec. 5
25	Oct. 29	Nov. 8	Nov. 17	Dec. 3	Dec. 21
50	Nov. 5	Nov. 17	Dec. 3	Dec. 19	——
75	Nov. 14	Nov. 26	Dec. 18	——	——
90	Nov. 24	Dec. 6	——	——	——

rare that there is less than a 50-50 chance that it will occur even in January.

In the fall, cotton bolls that are in an immature state; that is, green and contain a high amount of moisture, are quite sensitive to freezing temperatures. If the moisture inside the hard shell freezes, the boll will rot and make no cotton. On the other hand, a very light freeze or frost is sometimes quite beneficial by naturally defoliating the plant and speeding up maturity of new bolls.

Table 12 shows the probability that certain low temperatures will occur on or before particular dates. Readings across the middle row show the average dates of certain temperatures. For 32-degrees the average is November 5, 28-degrees averages on December 19. The low readings of 16-degrees occur on about 3 years out of 10 so there is no normal date for that low temperature. Early freezes in the 28- to 32-degree range are more harmful to most of the crops grown in the Delta than are the later hard freezes. The 10-percent probability indicates that the first 32-degree readings comes as early as October 19 and the first 28-degree reading as early as November 1 on one year out of 10. As with the spring temperatures, the dates on Table 12 apply to the central Delta with a 3- to 4-day delay in the south Delta and 3 to 4-day earlier arrival in the north Delta.

Of great importance though, is the variation that occurs due to local exposure. Crops in shallow hollows tend to have low temperatures sooner than crops on the rises. This is because cool air, like water, flows down hill. On a cool spring or fall night, temperature differences of 10 degrees occur between areas on low and high places.

Soil temperatures.—Figure 5 gives an estimate of the soil temperature of the seed zone at planting time. Limited soil temperature measurements at Stoneville in the springtime indicate that the average temperature in the upper 2 inches of the soil closely ap-

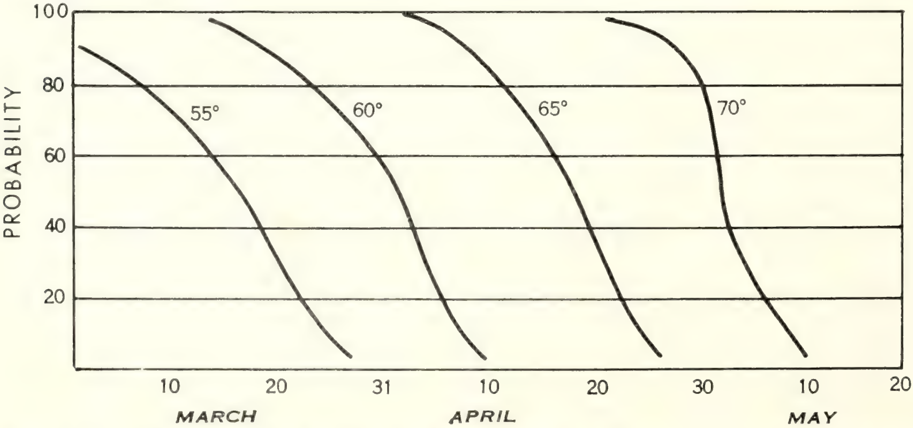

Figure 5. Probability that the average soil temperature will reach certain levels during the spring.

Table 13. The probability that the minimum temperature will be less than certain values in the fall.

Temperature	Probability 10%	 50%	 90%
60° or less	Sept. 15	Sept. 25	Oct. 10
55° or less	Sept. 25	Oct. 10	Oct. 25
50° or less	Oct. 8	Oct. 23	Nov. 10

proximate the average air temperature. Due to the lack of complete soil temperature data, the average air temperature is used in the graph as an estimate of the soil temperature.

Research by the Delta Branch Experiment Station indicates that an average soil temperature of 70° is optimum for proper cotton seedling emergence. A temperature of 65°, however, is considered to be a practical level for planting. Less than 65°, however, is too low for good emergence. Results of the Station's experiments give emergence of 10 percent at 60° soil temperature, about 75 percent at 65°, and 93 percent at 70°.

As shown in Figure 4, the soil temperature normally does not reach an average of 70° until May 1. The 50-50 chance of the soil temperature reaching 65° occurs about April 16. Planting before the first of April gives only about 3 to 4 chances out of 10 that the soil temperature will be high enough to give a minimum of emergence.

Daily Fall Temperatures.—The efficiency of chemical defoliants on cotton is known to be related to air temperature. In some experiments, a temperature of 60 degrees or less has been observed to stop defoliation; that is, the leaf is killed but does not drop off. With this in mind applications should not be attempted when the temperature is expected to be below 60 degrees for an appreciable length of time. Normally, if the minimum temperature drops to 60 degrees, it maintains this low reading for less than an hour. In like manner, if the minimum temperature drops to 55 degrees, a temperature of less than 60 degrees is maintained about 3 hours, while if the minimum drops to 50 degrees, it stays below 60 degrees for an average of 5 hours or longer.

Throughout the month of August and September, there are a few cool snaps that drop the temperature to less than the indicated readings and occasionally this happens even in July. This unseasonable cool weather is usually heralded by forecasts and application of defoliants can be avoided. Of more importance in efficient defoliation is the answer to the question, "When does the temperature start averaging below the efficient limits?" Table 13 answers the question by giving the probabilities of certain minimum temperatures.

Sunlight

Sunshine is a major control over crop development. In early springtime, sunshine is a major control of soil temperature in the seedbed. After the plant is up, the variation in sunlight determines the rate of photosynthesis. During the life of a plant, variations in sunlight effect many of the physiological processes, for example—lack of sunshine leads to boll shedding. Through the year sunshine effects the rate of evaporation from the soil and transpiration from plants.

Percent of Sunshine.—The sun shines 61 percent of the daylight hours in the Mississippi Delta; however, there is considerable variation from year to year and from winter to summer as shown in Table 14. Only one year in ten has sunshine been less than 52 percent of the daylight hours and only one year in 20 can be expected to have sunshine less than 48 percent of the daylight hours.

Summer is the sunniest season and winter has the least sunshine. The normal sunshine in winter is 43 percent of the daylight hours while in the spring and summer, that small amount

Table 14. Probability that the seasonal and annual sunshine will be less than certain amounts. The figures in the table indicate the percent of the daylight hours that the sun is expected to shine.

Probability	Winter	Spring	Summer	Fall	Annual
95	53	68	81	76	68
90	52	67	80	74	67
75	51	64	76	70	64
50	46	61	73	66	61
25	40	55	64	63	57
10	33	49	56	50	52
5	31	47	53	39	48

Table 15. Probability that the monthly sunshine will be less than certain amounts. The figures in the table indicate the percent of the daylight hours that the sun is expected to shine.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	61	65	63	74	80	91	82	83	85	85	77	59
90	59	60	60	72	77	89	79	80	82	82	73	57
75	53	54	58	67	73	82	73	78	77	77	66	53
50	45	46	53	60	66	70	68	75	72	74	57	47
25	32	37	48	50	60	56	60	68	66	63	48	39
10	21	30	43	43	52	46	52	57	45	47	42	32
5	15	28	41	41	48	42	49	53	30	39	38	30

Table 16. Mean daily solar radiation — Langleys per day.

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
192	269	359	456	529	574	552	515	451	361	257	196

of sunshine occurs less frequently than once in 20 years.

Table 15 shows the monthly variation in percent of daylight hours with sunshine. January has only 45 percent sunshine on the average while August has 75 percent sunshine. From February to March and from March to April the average sunshine increases about 7 percent. From October to November, the average sunshine decreases 17 percent, the largest change between any two months.

The data in Tables 14 and 15 show only part of the variation of heat received on a Delta field due to sunlight. These two tables show that the percent of cloudiness decreases sharply from winter through spring with a very sharp increase occurring from October to November. But added to this effect of changing cloud cover, the long days of early summer and the short days in winter, combine with changing cloud cover to give much more heat from the sun in summer than in winter.

Solar Radiation.—Table 16 shows the average daily solar radiation for each month in the Delta. June has the maximum solar radiaiton of 574 Langleys per day. (A Langley is one gram calorie per square centimeter.) The June average is greater than the December and January averages added together. The greatest increase in solar radiation between the months is from March to April. In March the radiation averages 62 percent of the maximum in June, in April the radiation averages 79 percent of the maximum which gives an increase of about 17 percent from March to April. This accounts, at least in part for the rise in soil temperature that takes place in April and again points to April as being the favored month for planting. The largest decrease in radiation between the months occurs from October to November. In October the average rate of radiation is 63 percent of the June maximum and in November it is only 45 percent of the maximum, which is a drop of 18 percent and is indicative of the drop in drying power as the season progresses from October through November. The sun reaches its highest point in the sky in late June, which makes this the time of greatest solar radiation. It is interesting to note that August has a greater percent of sunshine during the daylight hours than either June or July, but the daily rate

Table 17. Time of sunrise and sunset, Central Standard Time.

	Memphis		Vicksburg	
	Sunrise	Sunset	Sunrise	Sunset
January 1	7:08	4:59	7:06	5:10
February 1	6:59	5:29	6:59	5:37
March 1	6:30	5:56	6:32	6:02
April 1	5:47	6:21	5:53	6:24
May 1	5:10	6:45	5:17	6:45
June 1	4:46	7:09	4:58	7:06
July 1	4:48	7:19	5:00	7:15
August 1	5:09	7:03	5:18	7:02
September 1	5:32	6:27	5:39	6:29
October 1	5:54	5:44	5:58	5:49
November 1	6:21	5:06	6:20	5:14
December 1	6:50	4:48	6:48	4:58

of solar radiation is significantly greater in both June and July than it is in August.

Sunrise-sunset.—Table 17 shows the time of sunrise and sunset for Memphis and Table 18 for Vicksburg. These tables can be used rather simply to find the sunrise-sunset times for any place in the Delta within the accuracy limits of a minute or so. For example —Drew which is about half way between Memphis and Vicksburg, would have sunrise-sunset times half way between the two tables, Clarksdale, which is about two-thirds of the distance from Vicksburg to Memphis has a sunrise-sunset time of two-thirds of the difference in time between the two cities.

Evaporation

Variation of Evaporation.—Evaporation is the physical process of changing water from a liquid to a vapor and as such requires heat. Thus evaporation, by taking away heat, cools the surface from which moisture is evaporated. When the temperature of the surface drops to a critical level, evaporation stops. When the temperature drops to a lower critical value, the process reverses and dew or frost forms.

In a plant, moisture drawn up from the soil through the roots is evaporated from the leaves, and this process is called transpiration. Transpiration keeps the leaves cooler than they would otherwise be. Recently this cooling process has been found to be quite over-rated; that is, as far as cooling the leaves is concerned, transpiration is very wasteful of water and the plant would be better off to conserve its moisture for later use. However, there isn't much that can be done at present to change the plant's habit; we can merely try to satisfy its thirst by supplying additional moisture. Possibly in the future we can reduce conditions, on a local scale, that cause excessively high evaporation.

The average annual evaporation over the country measured by Weather Bureau pans varies from over 100 inches in southwest Texas to less than 30 inches in spots along the northern border of the country. Here in the Delta, the yearly rate of evaporation is about equal to the yearly rainfall. However this is quite misleading as far as the moisture balance is concerned.

Scott, which has pan evaporation records for 7 years, is representative of the Delta. During the three winter months, the evaporation at Scott has averaged about 8 inches while the rainfall averages about 14 inches. During the three summer months, evaporation averaged over 25 inches while rainfall averaged only 10 inches. For fields and plants, this means that evaporation practically stops due to the lack of available moisture during dry periods in summer.

In an enclosed area, evaporation is controlled by temperature, but in open areas it is also influenced by wind and humidity. The rate of evaporation increases on windy days and with periods of low relative humidity. This means that sheltered areas decrease evaporation.

Evaporation measurements were made in cotton fields at Stoneville during the fall of 1959. In a heavily leafed field of cotton about 5 feet tall, evaporation averaged 10 cc. at the one- and two-foot heights and 23 cc. near the top of the plants. In a defoliated field, evaporation averaged 18 cc at the one-foot height, 19 cc at the two-foot height and 25 cc near the top of the plants.

During the growing season this suggests that heavily leafed fields are more efficient moisture users. At harvest time, when cotton lint should be dry, defoliated fields dry out quicker than leafed fields and are thus more desirable as far as cotton quality in humid areas is concerned.

Variation of Evapotranspiration. — The combination of evaporation from the soil and transpiration from plants is called evapotranspiration and in this report is treated as a calculated value rather than a measured weather variable.

The Weather Bureau's Bioclimatological Section, headed by Mr. W. C. Palmer, computed the following data showing the moisture balance in the Lower Delta. The information is generally applicable to the Upper Delta as well. Table 18 shows the probability that evapotranspiration will be less than certain amounts. Evapotranspiration is considered to be the amount of moisture that should be available to the plant for optimum growth. The data were computed by Thornthwaite's formula which is based on variation of temperature and day length.

Evapotranspiration averages about half an inch in winter and about 7 inches in summer. Under the 50% heading in Table 18, you see that the average summer water use is about 6.30 in June, 7.10 in July and 6.60 in August. The peak water requirement occurs in July. Under the 95-percent probability, you see that somewhat less than 7.55 inches of water are required on the order of one year out of 20.

The range in moisture requirement in July, the biggest moisture user, is 1.25 inches. This means that on 9 out of 10 years, from 6.35 inches to 7.55 inches of water are used in keeping plants growing at the optimum rate. In table 3, it was shown that water supply ranged from only 0.5 inches to 7.5 inches on 9 out of 10 years; thus, the variation in water use is much less than the variation in water supply.

Table 19 shows the balance between rainfall and water use. During the winter and most of the spring and fall, the supply is greater than the use. The positive figures in Table 19 show the probability that monthly precipitation will exceed evapotranspiration by less than certain amounts. For example, in March the average balance between supply and demand indicates that there

Table 18. Probability that the evapotranspiration will be less than certain amounts.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	1.05	1.10	2.50	3.50	5.40	7.10	7.55	7.15	5.70	3.45	1.50	1.00
90	0.90	1.05	2.20	3.40	5.30	6.95	7.45	7.05	5.55	3.25	1.40	0.85
75	0.65	0.90	1.90	3.10	5.10	6.65	7.25	6.90	5.05	3.00	1.20	0.70
50	0.50	0.65	1.50	2.80	4.80	6.30	7.10	6.60	4.50	2.75	1.00	0.55
25	0.35	0.45	1.25	2.55	4.50	6.00	6.85	6.30	4.25	2.50	0.90	0.40
10	0.10	0.25	1.00	2.35	4.10	5.70	6.50	6.00	4.15	2.10	0.70	0.20
5	0	0.15	0.80	2.25	3.70	5.50	6.35	5.90	4.05	1.70	0.45	0.15

Table 19. Probability that the monthly precipitation will exceed the evapotranspiration by less than certain amounts and negative values indicate that the water shortage will be less than certain amounts.

Probability	Month											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
95	10.2	8.5	6.8	5.0	3.9	1.8	0.4	—1.0	0.4	3.4	7.5	7.7
90	9.5	7.6	6.0	4.4	3.4	0.8	—0.8	—1.4	—0.2	2.7	6.6	6.6
75	7.3	6.0	5.1	3.2	1.8	—1.0	—2.0	—2.6	—1.4	0.4	4.5	5.2
50	4.0	4.0	4.1	2.0	—0.2	—2.1	—3.2	—4.2	—2.3	—0.8	3.0	3.8
25	2.4	2.5	3.0	0.2	—1.7	—4.2	—5.1	—5.1	—3.4	—1.6	1.8	2.9
10	1.6	1.7	1.7	—1.0	—3.1	—6.0	—6.2	—6.0	—4.4	—2.0	0.0	2.0
5	0.9	1.0	0.4	—1.5	—3.8	—6.3	—6.4	—6.2	—4.9	—2.2	—0.7	1.5

Table 20. Probability that the monthly moisture deficit will be greater than certain amounts (assuming an available water holding capacity of about 5 inches).

Probability	Month							
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Record	0	3.24	6.48	6.39	5.38	2.15	0.31	0
20		1.15	5.15	5.19	3.80	1.60		
40		0.25	2.50	4.10	3.00	0.65		
50			2.28	3.53	2.12	0.38		
60			2.15	2.90	1.80			
80				0.50				
Percent of years having a deficit	0	48	67	85	75	59	7	0

will be an excess of close to 4 inches of water. In April the excess in rainfall is normally about 2 inches while in May, rainfall is normally less than evapotranspiration.

The minus values in Table 20 indicate a shortage of water. In June, the normal shortage is at least 2 inches, in July the normal shortage is at least 3 inches. The monthly shortage hits a peak of about 4 inches in August. During each summer month, about a fourth of the years are nearly 5 inches short of rain. On one out of 10 years, the shortage reaches 6 inches.

The monthly shortage drops in September and on normal years is about 2 inches. In October the rain and evapotranspiration about balance while in November there is an excess of about 3 inches of rain.

Due to the storage of moisture in the soil, plants have a reserve supply other than rainfall to meet their demands early in the summer; but by the middle of summer this supply is often exhausted. Table 20 shows the shortages of moisture that develop in a soil that can hold 5 inches of water. Actually much of the cotton land in the Delta holds less than this amount, and consequently the need is even more acute than the table shows.

June moisture deficiencies of consequence occur only about one year in five. The three months—July, August and September—have serious shortages about six years out of ten, and this three-month period has an average shortage of nearly 8 inches. The driest season of recent years was 1954, when the maximum shortage reached 16 inches.

In spring, water supply as compared with use is normally excessive in March, drops to adequate in April and becomes rather short in May. In the fall, the balance takes a sharp turn from dry to wet in late October. During the summer there is almost always a shortage as shown by Tables 18, 19 and 20. However, these tables indicate moisture requirements for optimum growth. In practice, some of this shortage is made up by the growth habits of the plant, but the evidence is strong that supplemental irrigation would be helpful during many periods.

Relative Humidity and Wind

Variation of Relative Humidity. — The most commonly used measure of atmospheric moisture is relative humidity. Relative humidity is the ratio of the actual amount of moisture in the air to the amount of moisture that the air could hold if it were saturated. Temperature influences relative humidity; warm air can hold more moisture than cold air. For example, if relative humidity is 100% on a summer morning with a temperature of 65 degrees, it will drop to around 40% in the afternoon if the temperature rises to 95 degrees. This is accomplished without the removal of any moisture.

Due to the influence of temperature, relative humidity falls to a minimum during the hottest part of the day, or just after noon. Relative humidity rises to a maximum during the coolest hours at night and very early morning. Shortly after sunset, the relative humidity may reach 100% and cause dew on grass. This is because the ground cools off rapidly, while 5 feet above the ground, the relative humidity may be only 50%-70% due to a slower rate of cooling of that higher air layer.

The relative humidity of the air in a cotton field is a good deal different from the relative humidity of the air at the same height above an open field. During the falls of 1958 and 1959, relative humidity was measured at a height of about one foot above the ground in well leafed fields and defoliated fields. The minimum humidity averaged about 10 percent lower in the defoliated field.

As shown in Table 21, noon-time relative humidity is a little higher during December, January and February than during the rest of the year. At night however, the relative humidity in summer is a little higher than it is in winter. During any month of the year, unseasonably warm dry weather is accompanied by low humidity and vice versa for rainy weather; however, relative humidity shows only slight seasonal variation.

Relative humidity varies greatly from wet to dry days. It varies considerably from the afternoon to the night-time hours. Humidity varies according to the height above the ground and according to the degree of shelter provided by growing plants and buildings. However, unlike temperature and rainfall, relative humidity shows very small seasonal differences.

Wind Speed.—Average wind speed is greatest in winter and early spring and least in summer (see Table 22). During the 6-month period May through October, the wind averages only about 75 percent of the November through April period. The 3rd and 6th columns of Table 22 show the fastest wind speed averaged over one mile of wind. For example the 57 miles per hour wind reported at Memphis in May would have

Table 21. Average relative humidity for Memphis and Vicksburg.

Month	Memphis				Vicksburg			
	Midnight	6 a. m.	Noon	6 p. m.	Midnight	6 a. m.	Noon	6 p. m.
January	78	82	66	72	84	82	65	67
February	77	81	62	67	84	80	63	65
March	74	79	57	60	83	79	57	59
April	74	80	54	57	87	82	57	60
May	79	82	55	58	92	84	59	64
June	81	84	55	58	93	85	59	67
July	82	85	56	59	93	87	61	70
August	82	87	54	60	93	88	59	71
September	80	85	52	61	91	87	57	70
October	80	85	50	63	92	84	55	66
November	76	81	54	65	89	83	55	64
December	77	81	62	70	86	82	64	68
Year (average)	78	83	56	63	89	84	59	66
Years of record	19	19	19	19	10	63	33	63

Table 22. Average wind speed and prevailing directions and the extreme mile of wind for Memphis and Vicksburg.

Month	Memphis			Vicksburg		
	Av. hourly speed	Prevailing direction	Fastest mile	Av. hourly speed	Prevailing direction	Fastest mile
January	12.0	S	56	8.5	N	35
February	11.4	S	51	8.7	N	47
March	12.0	S	54	9.0	S	40
April	11.5	S	51	8.4	SE	38
May	9.3	S	57	7.2	SE	49
June	8.4	S	51	6.6	SW	38
July	7.9	S	54	6.4	SW	46
August	7.2	S	47	6.2	SW	41
September	8.0	NE	51	6.8	N	47
October	8.2	S	47	6.9	N	31
November	10.0	S	47	7.8	SE	47
December	10.6	S	56	8.1	SE	49
Year (average)	9.7	S	57	7.6	SE	49
Years of record	10	10	47	78	75	46

been the average wind speed for about one minute. Peak winds, or gusts, are usually about 20 to 30 percent faster than the fastest mile.

Wind speed varies with height above the ground, the higher you are, the stronger the wind. (This is at least part of the reason that the Memphis wind average is greater than Vicksburg as shown in Table 22.) As a very approximate figure, the wind is doubled when the height is increased 10 times. For example—if the wind at one foot above a flat open field is 10 miles per hour, at 10 feet above the field the wind would be about 20 miles per hour.

Wind speed is also strongly influenced by the amount of shelter or obstruction. In a cotton field, the wind speed in the plant cover is only a fraction of the speed a short distance above the top of the plants. In the vicinity of trees, wind decreases sharply. On the leaward side of a line of trees 20 feet tall, the wind speed 100 feet away (5 times the height of the obstruction) would be only about 60% of the unobstructed wind speed while as far behind the trees as 400 feet (20 times the height) the wind would be only 90% of the unobstructed speed. Shelter belts of trees are frequently used in dry areas to reduce evaporation and thus conserve moisture. Even in the humid Delta, they would be of help in saving water during hot, dry periods.

Wind normally shows considerable variation from night to day with the strongest wind occurring during the hottest part of the day, or just after noon, and the least wind during the cool period at night. Important exceptions occur due to fronts, thundershowers, or squall lines which give short periods of strong wind. Intense slow moving low pressure disturbances coming in from the west, give prolonged periods of windy weather.

Figure 6 shows the percent of the time that the wind is less than 3-, 6- and 10-m.p.m. at a height of 10 feet above the ground for each hour. This data is adapted from observations taken at Memphis 1951-1958 and is considered to be representative of the entire Delta.

The hourly wind pattern is about the same during the winter months of December, January, and February. The three summer months—June, July and August—have similar wind patterns. During the spring, the wind increases in March and April but decreases in May. In the fall, the wind during September and October is rather similar to the summer months but November shows an increase.

During the hours of 9 a. m. through 4 p. m., the percent of the time that the wind averages less than 10 m.p.h. is: Winter 52%, March 39%, April 42%, May 67%, Summer 75%, September 72%, October 68%, and November 56%. Airplane sprays can be applied most of the time with a wind of about 10 m.p.h. and thus sprays can be applied even in the hot part of the afternoon in summer about 75% of the time. The percent of the good aerial spraying weather drops off in spring and fall. Aerial application of dusts require less wind and about 6 m.p.h. is the maximum. The early morning hours and the hours around sunset are best for dusts. The sharp change in wind speed is most noticeable around sunset during most of the year. The lightest winds occur between 7 p. m. and 9 p. m. during most of the year.

In addition to horizontal wind movement indicated in Figure 6, vertical movement is a hazard to the application of chemicals. During the day the sun warms the soil faster than it does the air just above the ground level. This causes convection currents. These rising columns of warm air are most frequent and reach their highest velocities just after noon on a sunny day and their variation is quite similar to the hourly wind variation shown in Figure 6. The drifting of materials due to the combined effect of vertical and horizontal air motion that occurs during late morning and early afternoon hours will decrease the efficiency of the treatment. The hazard is even more extreme with some herbicidal materials where drifts have caused damage to crops more than a mile from the treated area.

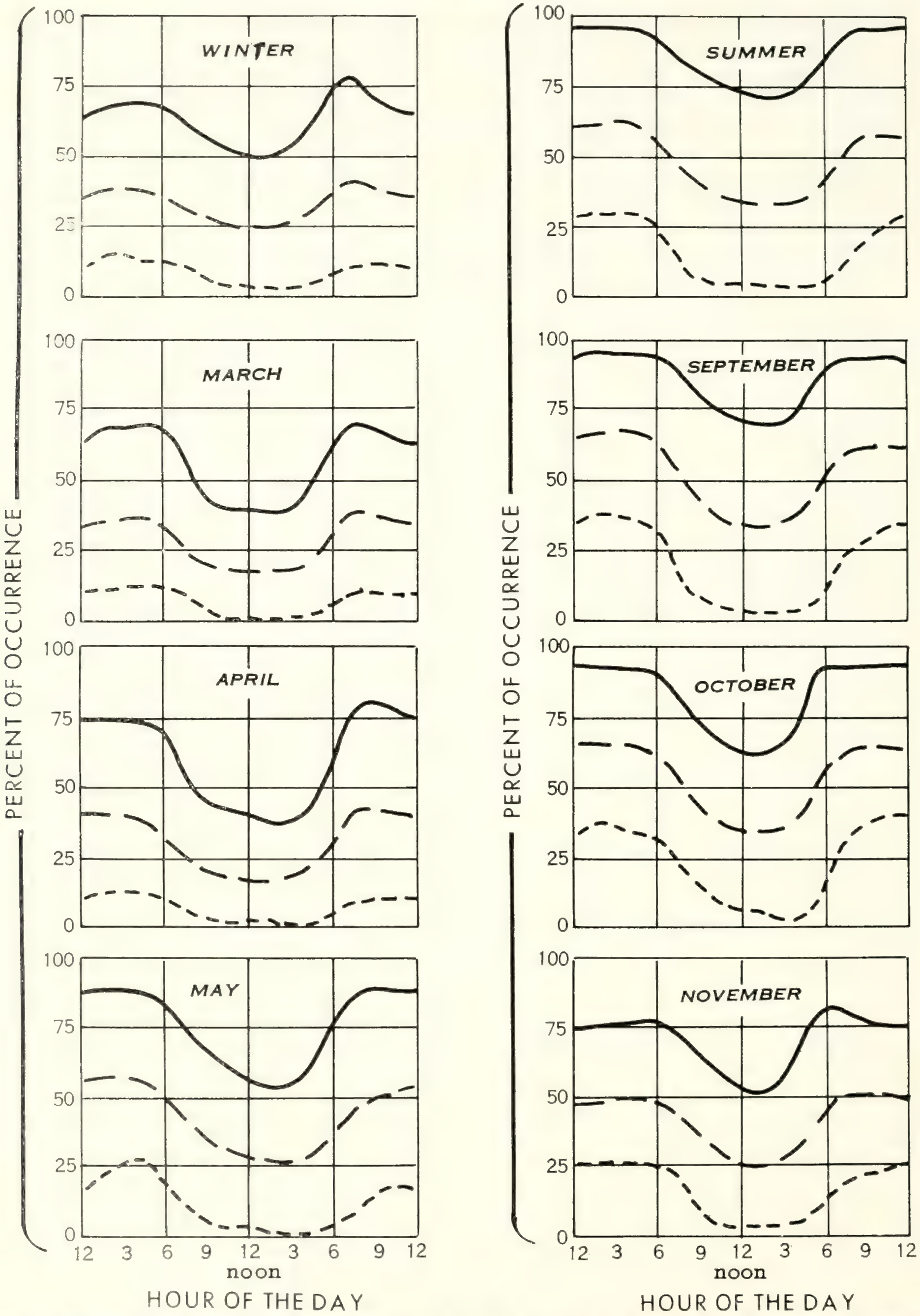

Figure 6. Percent of the time that the wind is less than 3 mph (— short dashed line), less than 6 mph (— — — long dashed line) and less than 10 mph (———solid line) at 10 feet above the ground for each hour. Data adapted from Memphis observations, 1951-1958.

Table 23. Prevailing wind direction for Delta locations.

	Clarksdale	Greenville	Greenwood	Rosedale	Scott	Stoneville
January	S	N	S	S	N	N
February	N	N	N	S	N	S
March	S	SW	S	S	S	S
April	S	SW	S	S	S	S
May	S	SW	S	S	S	S
June	S	SW	S	S	S	S
July	S	SW	S	S	S	SW
August	S	SW	S	S	S	SW
September	S	SW	S	S	S	S
October	SE	SW	N	S	N	S
November	N	N	S	N	N	S
December	S	N	N	S	N	N

Table 24. Percent of the time that certain wind directions prevail at Delta locations.

N	NE	E	SE	S	SW	W	NW
22%	1%	0	0	57%	20%	0	0

The maximum of wind speed between 11 a. m. and 4 p. m. has many agricultural implications besides the application of chemicals. Spray irrigation systems have a minimum of efficiency due to the gusty winds and higher rates of evaporation. Insects tend to hide under the cover of leaves and trash during this period due to combination of wind and high temperature. The decrease in wind at sunset is an important safety element in burning fields. Fire normally spreads much faster during the windy, hot and dry period of 11 a. m. to 4 p. m.

Wind Direction.—Wind direction is influenced by local obstruction; however, wind directions shown in Table 23 for Delta locations indicate that the wind prevails from some directions much more than others. The data for the 6 Delta locations are summarized in Table 24. Winds blow from the south 57 percent of the time. This has some very important agricultural implications especially when it is noted that the wind blows from the north 22 percent of the time. Added together, the wind is either directly from the north or south about 79 percent of the time. This suggests that furrows plowed on a north-south line would dry faster than those laid out east-west, if other factors such as drainage were equal. For a greenhouse, or any building, heat loss due to wind would be less if the long-side faces east-west rather than north-south.

Disaster Weather

Figure 7 shows the extreme mile of wind that can be expected to occur at 30 feet above the ground on an average of once in 50 years. Along the Gulf Coast, the 100 m.p.h. winds are caused by the infrequent but severe winds of hurricanes. To the north, the strong winds are caused by severe fronts and thunderstorms. Severe winds, of course, are not unknown in the Delta; however, this area has a favorably small number of occurrences.

Destruction caused by tropical storms varies from about once in 50 years in the north to about once in 10 years in the south Delta as shown by Figure 8. Normally the severe winds of hurricane force decrease greatly as the storm moves over land. This is usually the case for tropical storms that move as far north as the Delta and the rare occurrence of destruction from these storms in the Delta is mainly due to the heavy rains and local floods that follow the rain.

The yearly number of thunderstorms varies from 50 to 60 in the Delta as shown in Figure 9. The frequency of strong winds accompaning these storms however is much smaller than many northern areas that have fewer storms.

Figure 10 shows the average number of tornadoes (by 1-degree squares) during the 1953-1958 period. In the Delta the frequency is slightly less than 2 a year. One of the Delta's most severe tornadoes hit Vicksburg December 5, 1953, killing 38 and injuring 270; however, Figure 10 shows that many areas have had as many or more of these devastations storms than the Delta.

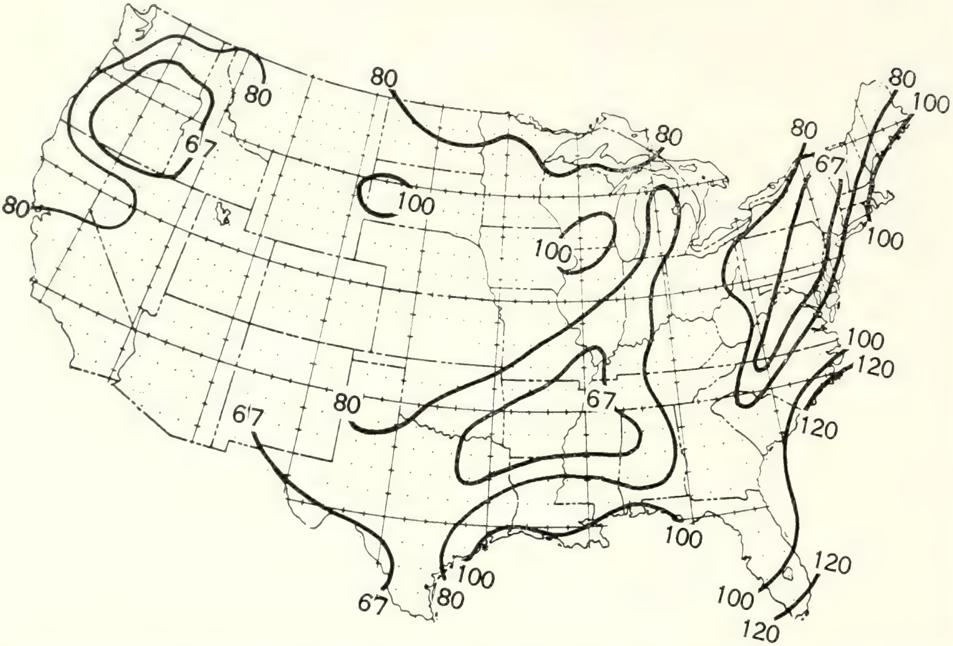
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Figure 7. Extreme mile of wind expected at 30 feet above the ground on a 50-year recurrance interval.

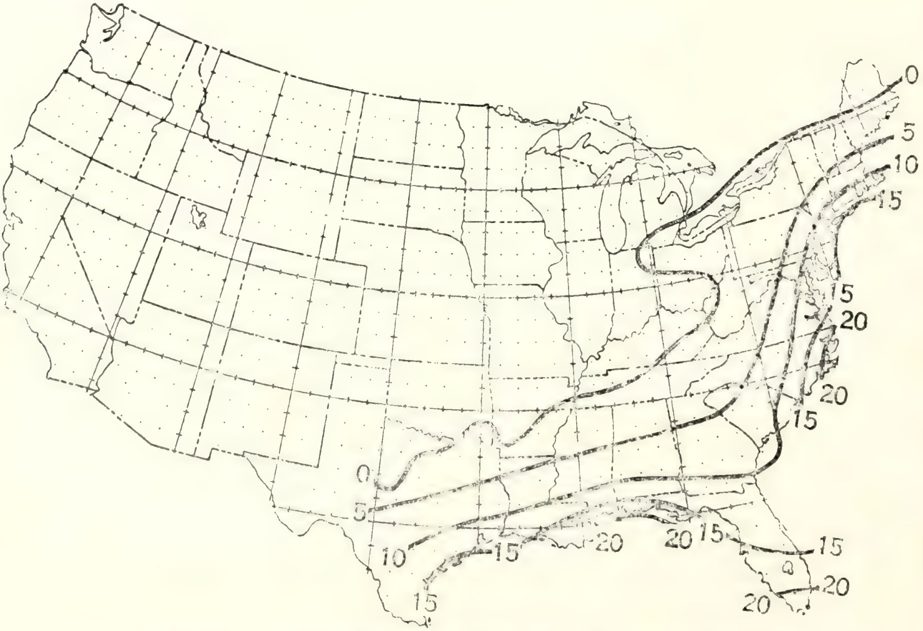
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Figure 8. Number of times destruction was caused by tropical storms, 1901-1955.

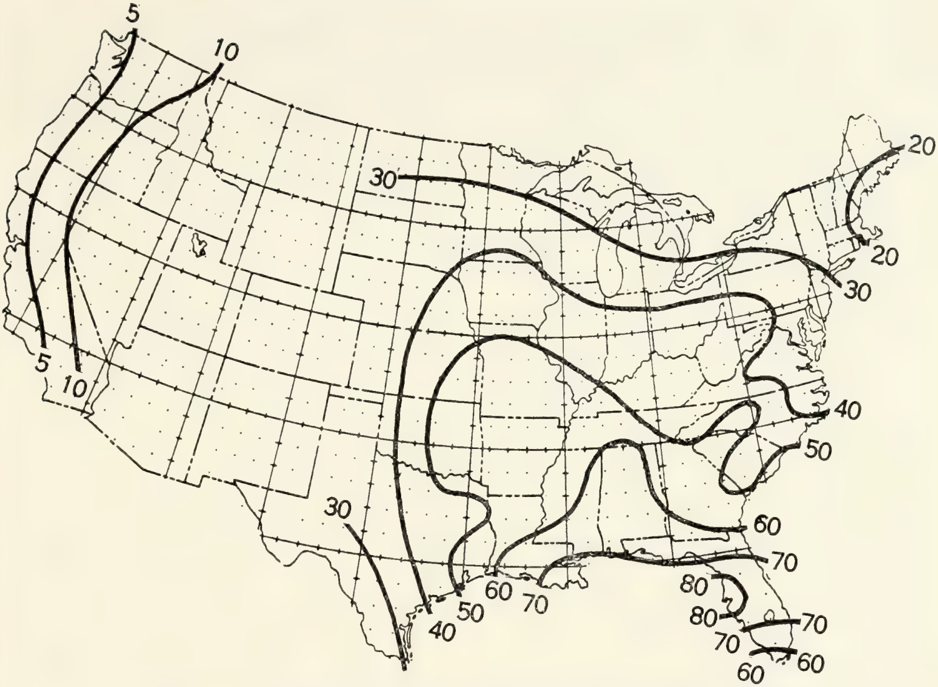
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Figure 9. Average annual number of days with thunderstorms.

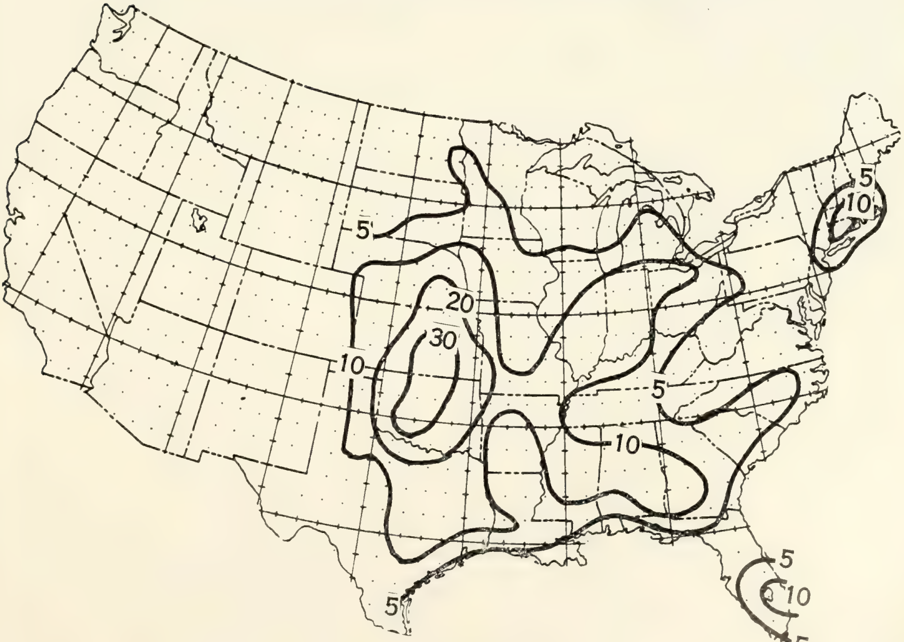
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Figure 10. Tornadoes 1953-1958 (By 1° Squares).

Is the Climate of the Delta Changing?

The preceding pages of this report indicate that the various weather elements—rainfall, temperature and sunshine—have shown extreme variation from time to time over the period of record. Whenever there is an extended period of wet or dry weather, or hot or cold, the cry goes up that the weather is changing and in a few years the Delta will be a desert or a lake.

The Delta area of Mississippi is one of the few areas of the world where there has been a large scale change in ground cover. Row crops have been substituted for trees and other semi-tropical plants. This change in vegetative cover undoubtedly has changed the climate somewhat. However, the changes that were brought about by the reduction in natural cover, probably took place many years ago when the land was being cleared. Trees supply moisture to the lower levels of the atmosphere over a long period of the year, and the elimination of such a vast area of trees has reduced to some extent, the moisture content of the lower part of the atmosphere.

The scope of this reduction is probably rather small in its effect in reducing rainfall. Also, the prevailing southerly winds near the ground and southwesterly winds a short distance above the ground have probably spread the small deficit of low level moisture, and the possible reduction in rainfall, over a wide area downstream (to the north and northeast of the Delta) rather than being concentrated in the Delta. In any event, it seems likely that the reduction in rain here in the Delta would have been very minor due to man's effort in removing the natural vegetation.

The scope of the reduction of low level relative humidity and the increase of low level winds is probably larger in its effect on surface evaporation. Low lying plants in the Delta dry out considerably faster now than they did in the days when forest covered a greater part of the area.

Figure 11 shows long-term rainfall averages and Figure 12, long-term temperature averages. The data is plotted by way of moving averages of 10-year periods. Variation from one year to the next is so extreme that long-term variation is obscured by yearly figures. The last year plotted in most cases is 1954 and represents the average for the 10-year period 1949 through 1958. The average plotted at 1953 represents the period 1948 through 1957 and so on back through the period of record.

On Figure 11, the long-term rainfall records at Memphis and Vicksburg show a large drop from about 1880 to the 1890s. At Memphis, annual precipitation has risen somewhat since then; at Vicksburg there has been very little trend since then. In the upper Delta, a general increase can be traced from about the turn of the century to date. In the lower Delta, there are no consistent trends.

The data included on Figure 11 suggest that in the Delta there is no trend for rainfall to become either heavier or lighter through the years. The data do show considerable fluctuation on the order of 10- to 50-year periods and though this eliminates long-range trends, it still leaves the possibility of changes due to cycles.

A cursory glance at Figure 11 shows no striking cycles. A more complete analysis indicates a rather pronounced minimum in 10-year precipitation in 1900 at Memphis, Batesville, Greenville, Yazoo City and Vicksburg, all of the cities with records that date that far back. A rather pronounced minimum also appears in 1939 at Memphis, Batesville, Clarksdale, Greenville, Greenwood and a less pronounced minimum at Yazoo City and Vicksburg. This coupled with the pronounced maximum during the early years of record at Memphis and Vicksburg, with a peak at 1870, are the three most significant features. From these data, it might be inferred that a cycle of about 40 years could have been imposed upon more obscure cycles and random fluctuations. That is, periods of extended light rainfall at the turn of the century and about 1940 with much less consistent maximum periods in between. This cycle has been observed in other areas of the country and conforms to some theories about the connection of sunspot cycles and their effect on weather. If this cycle of about 40 years is valid and continues without being absorbed by more obscure and unknown cycles

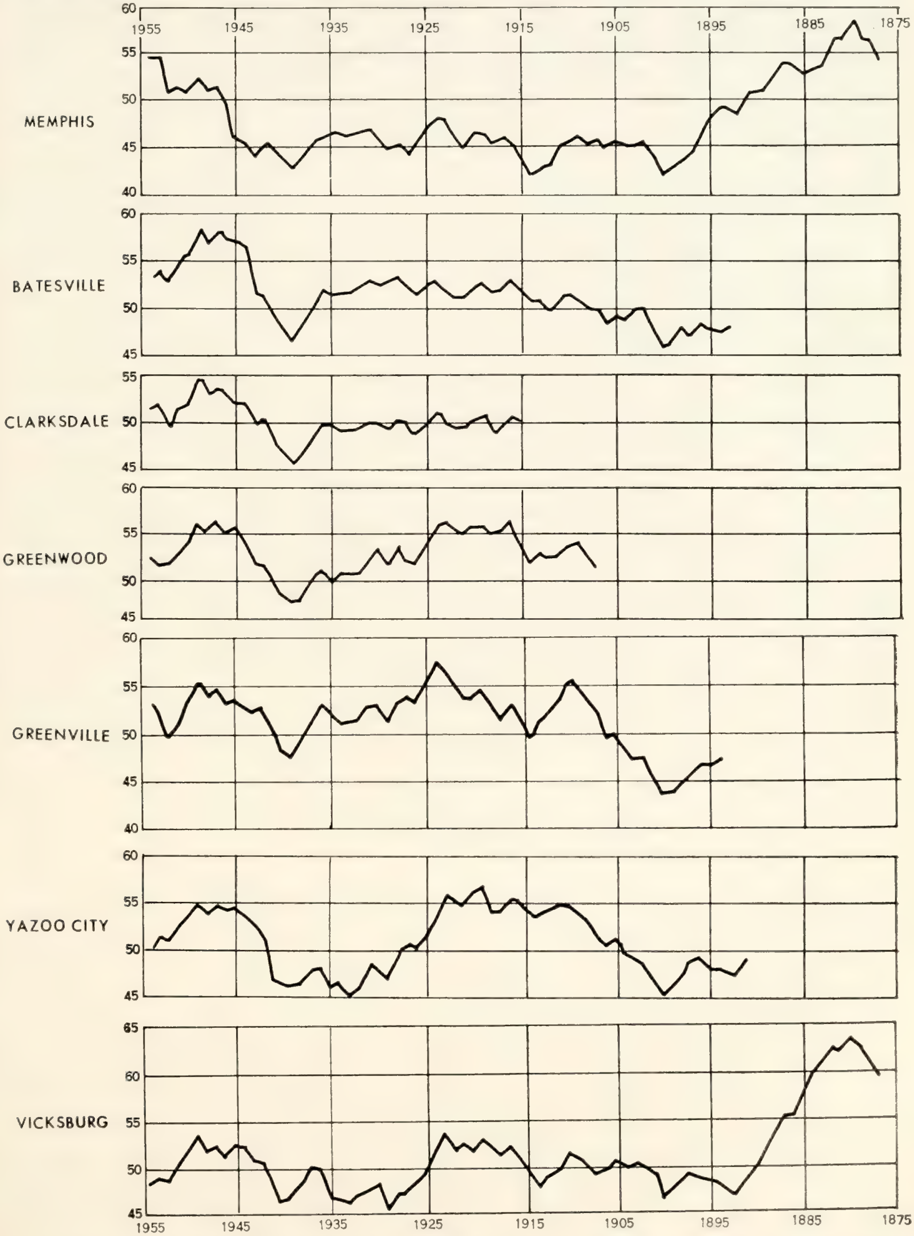

Figure 11. Variation of annual precipitation shown by moving averages of 10 years.

or by other unknown factors, another minimum in rainfall would be indicated for about 1980 or the late 1970s. As indicated by the above qualifications, this eventuality is quite remote at best.

Temperature variation in Figure 12 is shown by the same method of moving averages of 10 years. There is a rather pronounced maximum around 1935 at Memphis, Greenville and Greenwood and some indications of a minimum around the turn of the century. On the other hand, the temperature record at Vicksburg is quite stable with just over one degree variation for the 85-year period. There is an indication of a gradual rise in temperature as the four cities from around the turn of the century to 1935. Since then a trend is not detectable.

One conclusion from this discussion of weather cycles in the Delta, as well as much other work on the same subject in other areas is: If cycles or long-period trends exist in weather, they are very minor and difficult to observe in past records, and when it comes to extrapolating them into the future, they rarely if ever hold true.

A more practical value of the figures is the variability that is shown through the years. By necessity, agricultural research based on 10 years of data is considered to be fairly representative of growth characteristics. By reference to Figure 11, it can be seen that 10 years does not give a stable precipitation average. In Memphis, 10-year precipitation averages ranged from 58 inches to 42 inches; at Vicksburg, they ranged from over 63 inches to 45 inches. For a crop, or a crop practice, which is dependent on annual precipitation, these variations suggest that agricultural research must consider periods longer than 10 years.

Agricultural field experiments of longer than 10 years duration are expensive to say the least. The ultimate purpose of this report will have been served if the comparison of results of test years are further compared with the probability of occurrence of the various weather elements listed in this study. The weighted test data could be evaluated on the scale of the enlarged spectrum of weather variation that is likely to occur throughout the years.

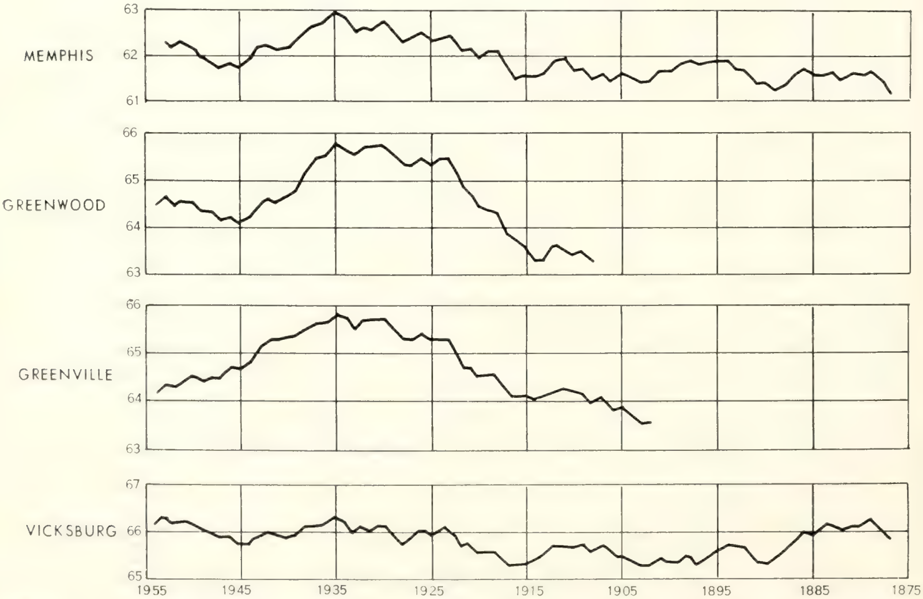

Figure 12. Variation of mean annual temperatures shown by moving averages of 10 years.

Bulletin 606 October, 1960

Plantation Organization and the Resident Labor Force, Delta Area, Mississippi

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The writers are indebted to the many plantation operators and workers whose cooperation in providing statistical material made this study possible. They wish to also express their appreciation for the assistance of those who carried on the field interviewing.

SUMMARY AND IMPLICATIONS

This is the second of a series of publications dealing with farm labor and technology on large cotton plantations in the Delta Area of Mississippi. The data for the study were obtained during March and April 1958 through personal interviews with plantation operators, resident farmworkers, and farmworkers who lived in selected Delta towns. The sample for this phase of the study includes 40 plantations having cotton allotments of 300 acres or more in 1957 and 172 Negro families living on these plantations.

The sample plantations averaged 1676 acres. About three-fourths of the total plantation area was cropland. An average of 407 acres, or about a third of the cropland, was planted to cotton. Soybeans, corn, oats, and wheat were other important crops raised.

Thirty-nine percent of the cotton allotment acreage was worked by sharecroppers and 52 percent by "day-hands;" 9 percent was in the Soil Bank. In 1957, the resident labor force performed 68 percent of the cotton chopping and 67 percent of the hand-picking done on the survey plantations.

Almost a third of the households had 7 or more members. Ninety-five percent of the 565 persons 10 years old or over in the survey households had done some work during 1957.

The age distribution of the plantation residents indicates that young people have been leaving large cotton plantations in the Delta Area of Mississippi. The deficiency of people was greater in the group 25 to 34 years of age than in the 14-24 and 35-44 groups.

Almost three-fourths of the males but only 15 percent of the females 10 years old and over were reported as mainly in the labor force. However, 98 percent of the males and 92 percent of the females 10 years old and over had engaged in some type of farm work during 1957. Workers who spent most of their time in the labor force averaged 91 days of employment during 1957 compared with an average of 67 and 65 days, respectively, for housewives and school youth.

In 1957, the average cash income for all plantation households surveyed was $845. Fifty-nine percent of the households received all their farm income from farm wage work, 28 percent received farm income from sharecropping and farm wage work, and 13 percent received all their farm income from sharecropping.

The seasonal nature of cotton production, which means that many workers are required for relatively short periods, is reflected in the average number of days worked and the earnings reported by plantation residents. If more productive use is to be made of manpower on large cotton plantations, additional opportunities for farm or nonfarm employment are needed.

In considering methods of increasing the employment and earnings of plantation residents, it should be noted that although women and children are an important segment of the plantation labor force, farmwork is usually not their major activity. They tend to be short-term workers employed during periods of peak labor needs.

Plantation Organization, and the Resident Labor Force, Delta Area of Mississippi[1]

By Nelson L. LeRay, George L. Wilber, Grady B. Crowe[2]

INTRODUCTION

The agricultural economy of the Delta area of Mississippi is based on the production of cotton. Labor requirements in producing cotton are not continuous throughout the year. They come to sharp peaks at chopping and picking times. Plantation operators use various labor policies to help guarantee them a supply of labor at these peak periods. Mechanization is making this problem more complex by reducing labor requirements.

The large plantation operator has three potential sources of farm labor for seasonal jobs: Individuals who live on the plantations, day-haul labor, and migratory workers. Primary dependence is on plantation resident and day-haul labor. Little migratory labor is employed in the Delta.

Labor requirements on large cotton plantations in the Delta area of Mississippi have been lowered significantly in recent years. The reduction in total man-hour requirements has been due mainly to two factors: (1) The shift from intensive to extensive enterprises; and (2) the introduction of new technology.

By 1957, cotton allotments and the Soil Bank Program had reduced cotton acreage 40 percent below 1953 plantings. Farmers who were searching for alternative crops to plant on the acreage coming out of cotton shifted primarily to soybeans, oats, and wheat, production of which has been highly mechanized for some time. These crops have considerably lower labor requirements than cotton, and for the plantations covered here, this shift accounted for an average reduction in labor requirements of roughly 30 percent from 1953 to 1957 inclusive.[3] Reductions in numbers of workstock were just about enough to offset increases in numbers of other livestock, so that man-hour requirements for livestock changed very little.

The use of new techniques and the expanded use of other modern technology also acted to influence labor requirements on Delta plantations. Although such new techniques as deep tillage and supplemental irrigation lowered unit labor requirements they actually increased labor requirements per acre. Others, such as a shifting to higher multiplerow equipment and increased mechanical harvesting of cotton, lowered both per unit and per acre labor requirements. The net effect of the expanded use of new technology on the 40 plantations studied resulted in an average reduction of about 10 percent in man-hour requirements from 1953 to 1957.

When the reduction in labor requirements resulting from changes in enterprises is combined with the reduction resulting from changes in technology, the total decrease in labor requirements per plantation from 1953 to 1957 inclusive was about 40 percent. However, a 40 percent reduction in labor requirements on a farm does not mean that 40 percent fewer workers are needed. There is no direct correlation between reductions in labor requirements and reductions in numbers in the labor force. Because of the peculiar nature of agriculture, some reductions in labor requirements affect the number of workers needed very little but do affect the length of time for which they are needed. Because of this, the reductions in labor requirements have created problems as to the efficiency with which labor is used.

---

[1] This report is part of a larger study of labor in the Mississippi Delta conducted cooperatively by the Farm Economics Research Division, Agricultural Research Service, and the Division of Sociology and Rural Life, Mississippi Agricultural Experiment Station. An earlier report, "Labor and Technology on Selected Cotton Plantations in the Delta Area of Mississippi, 1953-1957" by Nelson L. LeRay and Grady B. Crowe, Mississippi Agricultural Experiment Station Bulletin 575, April 1959, dealt primarily with trends in labor requirements on large cotton plantations as related to technological changes, participation in Government Programs, and changes in crop acreages and production.

[2] Agricultural Economist, Farm Economics Research Division, Agricultural Research Service, United States Department of Agriculture, stationed at Washington, D. C.; Sociologist, Mississippi Agricultural Experiment Station; and Agricultural Economist, Farm Economics Research Division, Agricultural Research Service, United States Department of Agriculture, stationed at Delta Branch Experiment Station, Stoneville, Miss., respectively.

[3] As the most significant adjustments affecting farm labor have occurred on the larger operations, changes for the whole Delta area may not be as pronounced as those found on the sample plantations.

This report deals with one phase of a study, the main objectives of which were: (1) To analyze trends in labor requirements since 1953, on large Delta cotton planations in relation to technology, participation in Government programs, and changes in crop acreages and production; (2) To determine the present requirements on these cotton farms for workers of various types—croppers, resident wage workers, dayhaul workers, and migrants; (3) To determine the significant characteristics of the farm labor force in the area and in relation to these characteristics, appraise possibilities for future adjustment.

The objectives of this report are (1) to discuss the organization of large cotton plantations in the Delta area of Mississippi; (2) to present the significant characteristics of the resident labor force; and (3) to ascertain availability of labor for crops and livestock production.

Method of Study

The data for the study were obtained during March and April 1958 through personal interviews with farm operators, resident farmworkers, and farmworkers who lived in selected Delta towns.

This report is based on interviews conducted with 40 plantation operators and 172 Negro families living on plantations where operator interviews were conducted. A stratified systematic list sampling method was used to select the survey plantations from Agricultural Stabilization Committee Work Sheets. A random sampling method was used to select respondents for the worker interviews.

As the more significant changes affecting farm labor have occurred on the larger operations, the universe was restricted to plantations having cotton allotments of 300 acres or more in 1957. Thus, for purposes of this study, a plantation is regarded as a continuous tract, or closely adjacent tracts, of land with a cotton allotment of 300 acres or more in 1957 and accompanying production resources, operated as a single working unit with respect to a central farm headquarters and the control of labor, cropping systems, and agricultural production.

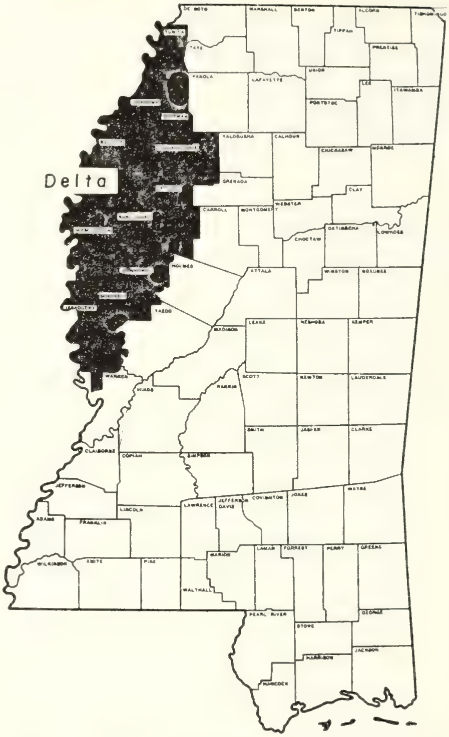
Delta
DE SOTO
MARSHALL
BENTON
ALCORN
TISHOMINGO
TUNICA
TATE
TIPPAH
PRENTISS
PANOLA
LAFAYETTE
UNION
LEE
ITAWAMBA
PONTOTOC
YALOBUSHA
CALHOUN
CHICKASAW
MONROE
GRENADA
CLAY
CARROLL
MONTGOMERY
WEBSTER
OKTIBBEHA
LOWNDES
CHOCTAW
HOLMES
ATTALA
WINSTON
NOXUBEE
ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
WARREN
HINDS
RANKIN
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
LINCOLN
LAWRENCE
JEFFERSON DAVIS
COVINGTON
JONES
WAYNE
ADAMS
FRANKLIN
WILKINSON
AMITE
PIKE
MARION
LAMAR
FORREST
PERRY
GREENE
WALTHALL
PEARL RIVER
STONE
GEORGE
HARRISON
JACKSON
HANCOCK

Figure 1. Map of Mississippi and Delta Area.

Characteristics of Plantation Labor Organization

The plantation has been used in many parts of the world as a method of promoting colonization. The plantation system is generally characterized by large land holdings, close supervision of labor, and specialization in production of one main cash crop, for example, tea, sugar, coffee, tobacco, or cotton.

In the United States, the plantation system is found mainly in the Southeast and is associated primarily with production of cotton, tobacco, sugarcane, and rice. During early colonial times, plantation operators depended on free and indentured labor. This labor was displaced by Negro slaves. Sharecropping began soon after the Civil War and persisted relatively unchanged until the advent of mechanization.

Under the old system of sharecropping, the plantation operator furnished the land, dwelling, fuel, tools, workstock, feed for workstock, seed and half the fertilizer, poison and ginning. The share cropper furnished the other half of the fertilizer, poison and ginning, and all of the labor. Landlord and cropper each received half of the crop. Although, there were many modifications this was the usual arrangement.

Since the introduction of the tractor, the cotton plantation has undergone a reorganization as complete as the one experienced after the Civil War; but the plantations retain their main employment and management characteristics—close supervision of labor and specialization in production.

World War II accelerated the change from cropper to wage labor, which began with the introduction of the tractor, and promoted the system whereby the cropper was given a smaller acreage of cropland than formerly. The operator performed many of the production and harvesting operations for the cropper, charging the expenses against the cropper's share of the crop or reducing the proportion of the crop received by the cropper.

The plantation operator is still responsible for managing the plantation. He directs or supervises the plantation operation and controls the land through ownership, lease, or other rental arrangements, or by virtue of employment as a hired manager. Tenants and wage hands work under his supervision.

The crop work on plantations is performed chiefly by sharecroppers (sometimes referred to as "half-hands" or "half-tenants') and wage workers. Sharecroppers are closely supervised by the plantation operator. Croppers usually furnish all hand labor and bear part of the expenses for machine work, fertilizer, poison, and ginning in return for a share of the crops they produce. The landlord provides the initial outlay of operating capital; but the sharecropper eventually pays for his share of such cost by returning a portion of the crops produced to the landlord. If crop yields are poor or prices are low, the cropper's cash receipts are reduced substantially. But if the crop is a bumper one and prices are good, he receives a greater cash return. Sharecroppers frequently supplement their incomes by working as wage laborers when they are not working on their own crops.

Unlike sharecroppers, wage workers receive cash wages for their labor. In the Delta area of Mississippi, wage workers are classified into two general types according to residence—resident wage workers are individuals living on the plantations, and day-haul workers are individuals living in nearby towns who do farmwork on plantations. Most wage workers receive a daily wage for the days they work, or they are paid on a unit basis, for example, per acre chopped or per hundredweight of seed cotton picked. Other workers, mechanics and tractor drivers, for instance, often receive a weekly or a monthly wage.

The 1957 Season

Growing and harvesting conditions in the Delta vary from year to year, depending chiefly on the amount and distribution of rainfall. Cotton production practices must be adapted to the weather.

The 1957 production season was characterized by excessive rainfall. Early rains interfered with land preparation and planting. Planting, which is usually done in April and May, was extended well into June. Rains, continued into summer, and intensified the weed and grass problem, provided favorable conditions for insects, and interfered with normal production operations. Plants grew off early but fruited late. Most of the crop was set in August. Early freezing weather, coupled with continued rains, damaged both yield and quality of cotton.

GENERAL PLANTATION ORGANIZATION

The large cotton plantation in the Delta area of Mississippi is a complex agricultural enterprise. Before discussing the labor force, an understanding of plantation organization is necessary. This section of the report contains a discussion of the organization of the plantations where worker interviews were conducted.

Land Use and Crop Organization

The sample plantations averaged 1676 acres in size[4] and ranged from 934 to 3,130 acres. In the size group from 1,000 to 2,000 acres were 27 plantations, or more than 65 percent of the sample.

Nearly three-fourths of all farmland on the sample plantations was cropland (Figure 2). Thirteen percent of the land was in permanent pasture, 3 percent in woodland pasture, 8 percent in other woodland, and 3 percent in farmstead, roads, ditches, and wasteland.

Cotton was the chief cash crop on the 40 plantations studied. An average of 407 acres, or about a third of the cropland, was planted to cotton. Soybeans were raised on 26 percent of the cropland and occupied the next most important place in acreage of cropland per plantation. Soybeans were raised on all except one plantation. Corn, oats, and wheat are other important crops grown.

The Cotton Enterprise[5]

The importance of sharecroppers has declined on large cotton plantations in the Delta area of Mississippi. In 1957, 39 percent of the cotton allotment acreage was operated by sharecroppers and 52 percent by "day-hands"; 9 percent of the cotton allotment acreage was in the Soil Bank. The relative importance of croppers and wage workers on the survey plantations, expressed in terms of average acreages and proportion of cotton acreage handled by each, is shown in Table 1.

Of the 407 acres planted to cotton, an average of 174, or 43 percent, was in cropper cotton. The remaining 233 acres, or 57 percent, was in wage cotton.[6] Three plantations had all cropper cotton and 8 had all wage cotton. The number of plantations by percentage of cotton acreage in wage cotton in 1957 is as follows:

Percentage of cotton and acreage in wage cotton	Number of Plantations
Under 25	10
25 to 49	6
50 to 74	9
75 and over	15
Total	40

The typical operations performed in producing a cotton crop on large plantations in the Delta area of Mississippi are as follows: When cotton follows cotton, one of the first operations in preparing for the new cotton crop on most plantations is cutting the stalks from last year's crop. After the stalks have been cut, or if cotton follows a

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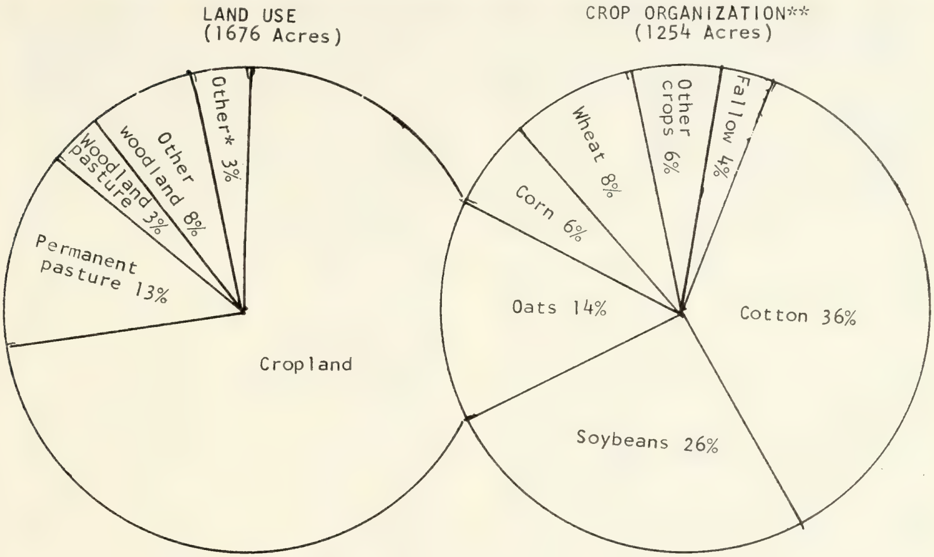
[4] Unless otherwise noted the term "average" as used in this report, refers to the arithmetic mean.

[5] See LeRay and Crowe, **op. cit.**, for a more detailed discussion of cotton production and harvesting practices.

[6] The "wage cotton" refers to the part of the cotton acreage that is not allotted to sharecroppers but is worked with hired labor or "day hands."



*Includes farmstead, roads, ditches, and waste.

**Includes double cropped acres.

Figure 2. Land Use and Crop Organization, Survey Plantation, Delta Area of Mississippi, 1957.

different crop, the land is plowed and harrowed, and beds are prepared for planting. After the land has settled, the ridges are knocked down or harrowed. Although some seed is hill-dropped, most of it is drilled in rows. Most fertilizer is applied as a side dressing after the cotton has been chopped and cultivated the first time. Most weed-control practices are still based largely on hand hoeing, as completely satisfactory mechanical or chemical techniques for performing this operation have not been developed. Herbicides, hand hoeing, machine cultivation, and cross-plowing are combined in many different ways to control weeds.

Poisoning to control the boll weevil and other insects is done by dusting and spraying with ground equipment and airplanes. The use of airplanes for poisoning is usually a custom operation.

Defoliation is sometimes necessary, when mechanical cottonpickers are used, as the grade of cotton is lowered when leaves are gathered with the lint. This is especially true, when the cotton plants are rank and succulent.

Livestock

Horses or mules, or both, were kept on three-fourths of the plantations. (Table 2). Mules were used mainly for running water furrows, hauling wood, hauling cotton sacks from the fields, and plowing gardens. Some plantations used horses in connection with their beef cattle enterprises.

The 28 plantations with cattle and calves had an average of 249 head. Hogs

Table 1. Cotton Allotment, Survey Plantations, Delta Area, Mississippi, 1957.

Cotton allotment in	Plantations reporting		Acreage, all plantations	
	Number	Average acreage	Average acreage	Percent distribution
Soil bank	8	216	43	9
Cropper cotton	32	217	174	39
Wage cotton	37	251	233	52
All plantations	40	450	450	100

Table 2. Average number of livestock on hand, Survey Plantations, Delta Area, Mississippi, January 1, 1957.

Livestock	Plantations reporting	Livestock reported
Plantations with	40	—
Workstock*	30	5
Cattle and calves**	28	249
Hogs and pigs**	7	102
Sheep**	3	404

*Includes all workstock on plantation.

**Does not include sharecropper's livestock.

and sheep were relatively unimportant on the large cotton plantations.

Machinery

Most of the survey plantations have mechanized the steps in producing and harvesting the cotton crop that can be performed with the machines now available. In general, operators of large cotton plantations in the Delta area of Mississippi have been early adopters of technological advances and have added improved machines to their farm organizations.

Tractors. Operators of large cotton plantations, with an average of 1,222 acres of cropland and 5 head of workstocks, have made the transition from mule power to tractor power. An average of 12.2 tractors of all types was reported on the plantations studied, (Table 3). On the average, 11.3 tractors were suitable for row work. Extra large wheel type and crawler-type tractors are not in general use for row work in cotton production. They are used for breaking, subsoiling, land leveling, and building and maintaining ditches. There was one tractor suitable for row work for approximately each 108 acres of cropland and each 36 acres of cotton.

Other Machines. The 38 plantations with mechanical cottonpickers reported a total of 74 and an average of 1.9 machines per plantation. Most mechanical cottonpickers were of the one-row type; however, 8 plantations reported two-row pickers in 1957.

The presence of mechanical cottonpickers is not as important as the use to which the pickers are put and the extent to which they are used. Comparison of the number of operators who have mechanical cottonpickers with the number who use mechanical pickers indicates that a few operators do not use their mechanical pickers each year. One of the 38 plantation operators with mechanical cottonpickers did not use his picker in 1957. In addition, 19 of the 30 operators with cropper cotton did not use their machines to harvest the cropper cotton.

Table 3. Selected farm machines, Survey Plantations, Delta Area, Mississippi, 1957.

Farm machines*	Plantations reporting	Av. per plantation reporting
	NUMBER	
Tractors**	40	12.2
Wheel type	40	11.9
Small	9	1.4
Medium	25	2.4
Large	39	9.7
Average	40	11.3
Extra large	19	1.3
Crawler type	10	1.2
Small	2	1.0
Medium	3	1.3
Large	6	1.0
Deep tillage plows or chisels	31	2.1
Anhydrous ammonia applicator	35	1.7
Planters	40	—
2-row	2	3.5
4-row	40	2.5
Flame cultivators	18	1.8
Other cultivators	40	—
2-row	17	1.9
4-row	40	6.0
Highboy	25	1.2
Cotton picker	38	—
1-row	33	1.9
2-row	8	1.4

*Does not include mule equipment.

**In general, small tractors are used with 1-row equipment; medium tractors with 2-row; and large tractors with 4-row equipment. Extra large tractors, usually 4-wheel units, are used primarily for breaking, subsoiling, and so forth.

Mechanical harvesting is popular with the operators of large plantations. It means less dependence on hand labor and the availability of mechanical pickers adds stability to handpicking rates. Operators do not use their machines to the fullest possible extent for several reasons: (1) Many resident workers would be idle if no handpicking were available; (2) Resident workers, who are needed for chopping, want to pick some cotton by hand and are given some work at handpicking in order to hold them on the plantation; (3) Skilled picker-operators and mechanics are not always available; (4) Weather sometimes prohibits picking with machines; and (5) Handpicked cotton grades higher than machine-picked cotton.

Deep tillage equipment was reported on 31 plantations and highboys on 25. All plantations studied had four-row planters and cultivators. Use of four-row planters and cultivators instead of the two-row machines formerly used, is particularly significant so far as the labor force is concerned. Use of the larger machine reduces the per acre labor requirements for these operations by almost 50 percent. Herbicide applicators were reported on more than half of the plantations. Two plantations had their own airplanes for spraying and dusting cotton.

Mechanization, along with the introduction of other new techinques, and a shift from intensive to extensive enterprises, is reducing the man-hour requirements for preharvest and harvest operations on large cotton plantations in the Delta area of Mississippi. However, plantation operators cannot manage without a large labor force for cotton chopping and weeding. In order to have workers available for hoeing, operators have not mechanized harvesting operations as fully as is possible under present levels of technology. As a result, plantation operators have not taken full advantage of many advances made in mechanical harvesting of cotton.

Labor Employed on Plantations

The seasonal nature of cotton production necessitates a large supply of labor for short periods of time. Large numbers of workers are required for cotton chopping in late spring and early summer and for harvesting in fall. Efficient cotton production requires a high degree of labor supervision in order to make the most of the crop and equipment belonging to the operator.

Many plantation operators prefer to employ both sharecroppers and wage workers. Employment of wage workers reduces both the heavy advances made to sharecroppers and losses from "bad accounts." Use of sharecroppers, on the other hand, provides the plantation operator with a core of more or less dependable workers around which to build his labor force.

Tenure Arrangements. The most prevalent tenure arrangement on the 32 large cotton plantations studied in the Delta area of Mississippi that reported cropper cotton in 1957, was the one in which the landlord received 50 percent of the crop and paid for all seed and half the fertilizer, poison, and ginning (15 plantations). The next most prevalent arrangement (14 plantations) resembled the first, except that the cropper paid for half the seed. When cropper cotton was irrigated or defoliated, the out-of-pocket expenses for these operations were shared equally by landowner and cropper. The cropper tenure arrangements on the 32 large cotton plantations reporting croppers in 1957 were as follows:

Percentage of landlord's share of cotton receipts and expenses	Number of plantations
Crop receipts:	
25%	1
50%	30
60%	1
Seed expenses:	
0	2
50%	14
100%	16
Fertilizer expenses:	
25%	1
50%	31
Poison expenses:	
25%	1
50%	31
Ginning expenses:	
0	1
50%	30
100%	1

Plantation operators usually prepared the land, planted the seed, machine-cultivated, fertilized, and poisoned the cropper's cotton. In addition, when cropper cotton was irrigated, defoliated, or machine picked, the landlord performed these operations. This arrangement leaves the cropper responsible for chopping his crop and handpicking the part not done by machine. When not working on their own crops, many croppers do farm wage work.

Resident Labor. In recent years,

many families have moved from plantations in the Delta area of Mississippi. This section presents a general picture of the resident plantation labor force. Other sections of this report present information on the role of the resident families in producing and harvesting cotton and other crops, as well as data on household composition through such measures as age, sex, education, work experience, and training.

The plantations studied had an average of 29 dwelling units, exclusive of the operator's or manager's house (Table 4). Thirty-five of the forty plantations had one or more unoccupied dwellings. There was an average of 23 occupied dwellings per plantation, of which eleven were occupied by cropper households and eleven by wage hand families; one was classified as "other".

Not all resident wage hands were from wage households, nor were all mechanics and nonworkers from "other" households. Most of the cropper households contained members who worked primarily for wages. Many of the cropper and wage households contained individuals who were employed as mechanics or as other types of overhead workers on the plantations. If any member of a household had a cotton crop, the household was classified as a cropper household.

The resident labor force is used primarily to pick and chop cotton. More plantations hire wage workers from cropper families to chop than to pick wage cotton. (Table 5).

Of the 37 plantations with wage cotton, 29 employed members of cropper families for chopping wage cotton, while 23 employed them for picking during 1957. On the 2 plantations with wage cotton but no wage families, the wage cotton was tended by nonresident wage workers and by croppers. In 1957, the resident labor force did 68 percent (in acres) of the cotton chopping and 67 percent (in bales) of the handpicking.

As it is still necessary to chop cotton by hand and to use some hand labor in picking cotton, many plantation operators have hesitated to rely completely on either resident, day-haul, or migratory wage workers. Plantation operators believe that the risk is too great to depend almost entirely for chopping and picking, on seasonal off-farm labor, supplemented by a small resident wage labor force. Therefore, it is the practice to assign small crops to resident families and to employ some members of these sharecropper families as wage hands. In addition, some operators assign acreages to families with tractor drivers and other skilled workers as insurance against these hard-to-replace workers leaving during times of peak labor demand.

Nonresident labor. Many plantation operators in the Delta area of Mississippi utilize the services of nonresident workers during periods of peak labor use. Day-haul workers were the primary source of nonresident labor for the 27 plantations that employed nonresident workers in 1957. No in-state

Table 4. Dwelling Units, Survey Plantations, Delta Area, Mississippi, 1957.

Dwellings	Plantations reporting	Average number of dwelling units	
		Plantations reporting	All survey plantations
		NUMBER	
Occupied*	40	23	23
Cropper**	32	14	11
Wage households	35	12	11
Other***	10	2	1
Unoccupied	35	7	6
Suitable for year-round use	35	7	6
Unsuitable for year-round use	2	4	****

*Does not include operator's or manager's dwelling.

**Includes 1 renter household.

***Includes foremen, strawboss, mechanic, and non-worker households.

****Less than 0.5 dwellings.

Table 5. Use of resident labor, survey plantations, Delta Area, Mississippi, 1957.

Item	Unit	Delta Area
Plantations with:		
Cropper cotton	Number	32
Wage cotton	"	37
Resident wage families*	"	35
Families:		
Cropper families per plantation reporting croppers	Number	14
Wage families per plantation reporting wage hands	"	12
Cropper cotton per cropper family	Acre	15.5
Wage cotton per wage family	"	20.9
Wage Cotton:		
Plantations on which croppers chopped wage cotton	Number	29
Workers from cropper families chopping wage cotton, per plantation reporting	"	39
Plantations on which resident wage families chopped wage cotton	"	34
Resident wage workers chopping wage cotton, per plantation reporting	"	33
Plantations on which croppers picked wage cotton	"	23
Workers from cropper families picking wage cotton, per plantation reporting	"	42
Plantations on which resident wage families picked wage cotton	"	30
Resident wage workers picking wage cotton per plantation reporting	"	34
Proportion of acreage chopped by resident labor	Percent	68
Proportion of bales of hand-picked cotton picked by resident labor	"	67

*Two plantations had wage cotton, but no wage families. The wage cotton was tended by non-resident wage workers and by croppers.

migrants were reported. One plantation employed out-of-state migrants for cotton chopping.

At the peak plantations employed an average of 78 day-haul workers for cotton chopping on plantations hiring non-resident workers, while the daily average number for 1957 was 48. The peak number of day-haul workers employed to pick cotton was 90 per plantation compared with a daily average of 50 workers.[7]

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[7] A detailed analysis of the characteristics of day-haul workers will be presented in the report, "Day-Haul Farm Labor Force in the Delta Area of Mississippi," to be issued as a Mississippi Agricultural Experiment Station Bulletin.

CHARACTERISTICS OF HOUSEHOLDS AND WORKERS

One objective of the study was to determine the nature of the resident labor force on large cotton plantations in the Delta area of Mississippi through such measures as age, sex, education, work experience, and training. The Negro rural farm population in the Delta area of Mississippi decreased ten percent during the decade of the 1940's.[8]

In addition, the number of croppers in the Delta declined by about a third between 1953 and 1955.[9]

Population changes of this magnitude have important implications for the economy of the Delta. The availability of workers of various types figure in many management decisions by plantation operators. Population shifts are also of concern to policymakers and administrators of public programs, who must keep pace with the requirements of a changing population.

There were 949 persons in the 172 households studied (Table 6). Forty percent of the individuals were under 10 years of age, 9 percent were 10 to 13 years old, and 51 percent were 14 years old or over.[10]

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[8] The Bureau of the Census, **Censuses of Population, 1940 and 1950.**

[9] **Effects of Acreage-Allotment Programs, 1954-1955.** United States Agricultural Research Service, ARS, December 1957, 43-47.

[10] The census definition of the labor force includes all persons 14 years old who are either (1) employed; (2) unemployed; or (3) members of the Armed Forces. In this report, detailed data are presented for individuals aged 10 to 13 because (1) many of these individuals chopped and picked cotton and (2) these individuals represent a sizeable group that will be available for full-time employment in the next few years.

Household Size and Number of Workers Per Household

In general, all persons living in a dwelling unit consituted a household. For purposes of this study, households included the head of the household and the immediate family as well as other individuals who shared a dwelling unit. A person living alone in a dwelling unit, or a group of unrelated persons sharing a dwelling unit, constituted a household. Individuals who were temporarily away from home were considered to be household members.

This procedure for delineating households resulted in some "double-up" families which were counted as single household units.

The two major types of households comprising double-up families occurred when: (1) a daughter was divorced or separated and living and working with her parents, and (2) when one or both parents were too old to support themselves and lived with one of the children, becoming part of the economic household unit.

Table 6. Characteristics of households, survey plantations, Delta Area, Mississippi.

Selected Characteristics of households	All households
	NUMBER
Total households	172.0
Total persons in households	949.0
Persons per household	5.5
10 years of age and over	3.3
14 years of age and over	2.8
Total persons:	
10 years of age and over	565.0
14 years of age and over	481.0
Households with:	
Male heads	166.0
Female heads	6.0

The households ranged in size from 1 to 15 persons. The average was 5.5 persons with an average of 3.3 persons 10 years of age or over. About 97 percent of the households had a male as the head (Table 6).

Large households were not uncommon. Almost a third of the households had 7 or more members (Table 7). There were 7 households with 10 members, 4 with 11 members, and 9 with 12 or more members. The households with 7 or more members averaged 4.7 individuals under 10 years of age compared with an average of 1.1 for households with fewer than 7 members.

Most of the household members 10 years old or over had done some farmwork during the preceding year. Of the 565 persons 10 years old or over in the survey households, 536, or 95 percent had done some work during 1957 (Table 8). Workers per household averaged 3.1. Sixty-nine percent of the households reported from 1 to 3 workers, while 11 percent reported 4 workers and 20 percent reported that 5 or more household members had done some work in the preceding year. The group of large households with 7 or more household members included 52 percent of all household members, 65 percent of individuals under 10 years of age, but only 44 percent of the employed individuals.

Table 7. Number of persons in households, by sex of household head, Survey Plantations, Delta Area, Mississippi.

Persons in household	All households		Households with			
			Male heads		Female heads	
	Number	Percent	Number	Percent	Number	Percent
Total	172	100	166	97	6	3
1	5	3	2	1	3	2
2	25	14	23	13	2	1
3	29	17	29	17	0	0
4	13	8	13	8	0	0
5	21	12	21	12	0	0
6	26	15	26	15	0	0
7	13	8	13	8	0	0
8	10	6	10	6	0	0
9	10	6	10	6	0	0
10	7	4	7	4	0	0
11	4	2	4	2	0	0
12 or more	9	5	8	5	1	*

*Less than 1 percent.

Table 8. Size of households by number of workers and number of persons, Survey Plantations, Delta Area, Mississippi.

Number of persons in household	Households	Number of workers					All persons	Persons under 10 years old	Persons 10 years old and over	Persons employed
		1	2	3	4	5 or more				
NUMBER										
All households	172	12	65	42	19	34	949	384	565	536
1	5	5	0	0	0	0	5	0	5	5
2	25	5	20	0	0	0	50	0	50	45
3	29	1	17	11	0	0	87	13	74	68
4	13	0	2	8	3	0	52	10	42	40
5	21	1	8	3	5	4	105	37	68	66
6	26	0	12	9	1	4	156	75	81	77
7	13	0	2	6	2	3	91	41	50	47
8	10	0	4	1	2	3	80	43	37	36
9	10	0	0	3	3	4	90	43	47	45
10	7	0	0	0	1	6	70	33	37	37
11	4	0	0	1	0	3	44	25	19	19
12 or more	9	0	0	0	2	7	119	64	55	51

Age and Sex

Males and females were represented about equally in the sample population (Figure 3). The age distribution of the plantation residents displays the characteristics of a group from which young people have been leaving. Half of the household members were under 14 years of age. Only 3 percent were 65 years old or over. Apparently, large numbers of Negro young men and women have left the large cotton plantations in the Delta area of Mississippi. Among those under 55 years of age, the deficiency of Negro residents is most pronounced for males 25 to 34 years of age.

Eighteen percent of the plantation residents were in the age group 14 to 24 years of age. Many individuals in

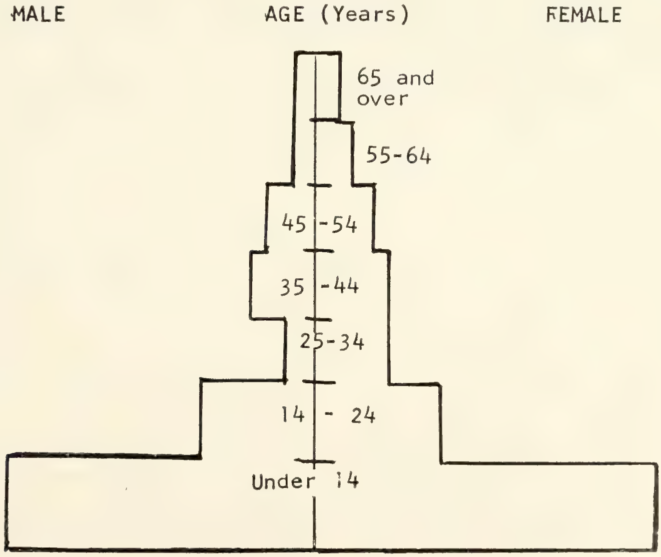

Figure 3. Age and Sex Distribution of Plantation Residents, Survey Plantations, Delta Area, Mississippi, 1957.

this age group have recently entered the labor force. Others should be available for full-time employment in the near future. Together with their younger brothers and sisters, these individuals represent an important segment of the present and potential labor force.

Educational Attainment

The outstanding aspect of educational attainment is the great improvement in educational level of young people as compared with their parents. Most individuals with high school training were in the younger age groups, while individuals of labor force age with little or no schooling were concentrated in the older age groups (Table 9). Between the ages of 14 and 24, the greater amount of schooling is particularly apparent. Nine percent of the labor force have some high school training, another 12 percent have completed grade school, and an additional 42 percent have received from five to seven years of grade school training. But 37 percent have not gone beyond the fourth grade. Females obtained more schooling than males. The median schooling completed was 5.7 years for males and 6.2 years for females.

Table 9. Persons 10 years old and over who had completed a specified number of grades in school, by age and sex, survey plantations, Delta Area, Mississippi.

		Persons who completed					
		Elementary School				High School	
Sex and age (in years)	Persons reporting*	Less than 1 year	1 - 4 years	5 - 7 years	8 years	1 - 3 years	4 years
				PERCENT			
All persons	100	4	33	42	12	8	1
Male	100	5	35	42	11	7	**
Female	100	2	32	42	13	10	1
				NUMBER			
Male	277	14	98	116	29	19	1
10 - 13	38	0	19	18	1	0	0
14 - 24	87	0	10	42	18	16	1
25 - 34	33	1	13	16	3	0	0
35 - 44	42	3	15	17	5	2	0
45 - 54	41	3	25	12	0	1	0
55 - 64	20	4	10	5	1	0	0
65 and over	16	3	6	6	1	0	0
Female	283	7	90	119	37	27	3
10 - 13	43	0	21	19	3	0	0
14 - 24	87	0	9	37	19	19	3
25 - 34	43	1	11	21	7	3	0
35 - 44	47	2	19	19	4	3	0
45 - 54	39	1	17	16	4	1	0
55 - 64	14	0	8	5	0	1	0
65 and over	10	3	5	2	0	0	0

*Five persons did not report.

**Less than 0.5 percent.

LABOR FORCE STATUS OF PLANTATION RESIDENTS

Information about utilization of the labor force is necessary in planning a program to meet the labor requirements of farmers and to better utilize the services of workers. In order to obtain the desired information, each person interviewed was asked to classify all members of the household ten years old and over according to their major activity during 1957.

It is difficult to make a simple and accurate occupational classification of plantation residents. Many individuals were employed at several different lines of farmwork during the previous year, while others combined keeping house or other activities with farmwork. The discussion that follows is intended as a general introduction to the major types of activities performed by the resident labor force on large plantations based primarily on age, sex, and household status. Other sections of the report relate these characteristics to days worked and earnings.

Sex, Age, and Major Activity

Almost three-fourths of the males but only 15 percent of the females 10 years old and over were reported as mainly in the labor force during 1957 (Table 10). All males in the age group 25 to 64 were mainly in the labor force, compared with 12 percent of the females. Keeping house was the major activity for 85 percent of the females. Although women and children constitute an important segment of the plantation labor force, farmwork is usually not their major activity. They tend to be short term and casual workers during periods of peak labor demand.

Of the 244 individuals having farmwork as their major activity, 23 percent reported their major activity as cropper and 16 percent as unpaid family worker; 61 percent said they did chiefly farm wage work. In general, the croppers were older than the unpaid family workers or wage workers.

Nonfarm work was not an important chief activity for plantation residents. None of the males and only 4 of the 285 females had nonfarm work as their major activity during the last year. All nonfarm workers were personal service workers.

Household Status and Major Activity

The major activity most frequently reported for heads of households was some type of farmwork. Approximately two-thirds of the male heads of households had farm wage work as their chief activity and 30 percent reported "cropper" as their major activity (Table 11). Only 1 percent was retired or unable to work.

Most wives spent the major part of their time keeping house and were not ordinarily in the labor market. All except 12 of the 162 wives in the survey had keeping house as their major activity. Of the 12 wives who had major activities other than keeping house, 2 were classified as nonfarm workers, 7 were farmworkers, and 3 were unable to work.

More than two-thirds of the sons and daughters 10 years old and over had "going to school" as their major activity during 1957. None of the sons or daughters had nonfarm work as their chief activity, while 35 percent of the sons and 25 percent of the daughters were either farm wage workers or unpaid family workers. Only 1 of the 101 sons on the survey plantations had "cropper" as his chief activity.

Respondents reported on more distant relatives and nonrelatives in addition to members of the immediate family within the household. Distant relatives and nonrelatives constituted 5 percent of the males and 8 percent of the females in the sample households. This group did not differ from other household members in relation to chief ac-

Table 10. Distribution of persons 10 years of age and over by major activity, sex and age, survey plantations, Delta Area, Mississippi.

Major activity	Total persons	Male				Female			
		10 - 13	14 - 24	25 - 64	65 and over	10 - 13	14 - 24	25 - 64	65 and over
	NUMBER								
All persons	565	40	87	137	16	14	87	144	10
Mainly in the labor force	248	2	54	137	12	1	25	17	0
Farmwork:									
Cropper*	55	0	2	42	7	0	0	4	0
Wage worker	150	1	34	95	5	0	12	3	0
Unpaid family worker	39	1	18	0	0	1	13	6	0
Nonfarmwork	4	0	0	0	0	0	0	4	0
Mainly not in the labor force	317	38	33	0	4	43	62	127	10
Going to school	144	38	33	0	0	42	31	0	0
Keeping house	159	0	0	0	0	1	30	122	6
Retired or unable to work	14	0	0	0	4	0	1	5	4

*Includes one tenant.

Table 11. Distribution of persons 10 years of age and over by major activity, sex, and family status, survey plantations, Delta Area, Mississippi, 1957.

Major activity	Total persons	Male			Female			
		Heads	Sons*	Others	Heads**	Wives	Daughters***	Others
					NUMBER			
All persons	565	166	101	13	6	162	95	22
Mainly active in the labor force	248	164	36	5	4	9	24	6
Farmwork:								
Cropper****	55	50	1	0	2	2	0	0
Wage worker	150	114	18	3	0	2	9	4
Unpaid family worker	39	0	17	2	0	3	15	2
Nonfarm work	4	0	0	0	2	2	0	0
Mainly not active in the labor force	317	2	65	8	2	153	71	16
Going to school	144	0	65	6	0	0	69	4
Keeping house	159	0	0	0	2	150	1	6
Retired or unable to work	14	2	0	2	0	3	1	6

*Includes sons-in-law.

**Includes both single women living by themselves and wives who were divorced or whose husbands had died or had left home.

***Includes daughters-in-law.

****Includes one tenant.

tivity, except that a higher proportion were retired or unable to work. Eight of the 14 household members who were retired or unable to work were not members of the respondent's immediate family.

The fact that large numbers of individuals had "keeping house" or "going to school" as their major activity indicates prospects for an expanded labor force. The future labor supply picture is especially bright with respect to sons and daughters still in school, many of whom should be available for full-time employment in the near future.

Type of Farmwork

Chopping and picking cotton are the major hand operations connected with making a cotton crop. Ninety-eight percent of the males and 92 percent of the females 10 years of age and over had engaged in some type of farmwork during 1957 (Table 12). Cotton chopping or picking, or both, was the major type of farmwork engaged in by 69 percent of the males and all of the fe-

Table 12. Distribution of workers by major type of farmwork, sex, and household status survey plantations, Delta Area, Mississippi.

Sex and household status	Persons 10 years of age and over	Persons employed	Major type of farmwork					
			Cotton					
			Chopping	Picking	Chopping and Picking*	Tractor driver	Mechanic	Other
					NUMBER			
All persons	565	535	8	42	400	75	5	5
Male	280	274	4	22	163	75	5	5
Female	285	261	4	20	237	0	0	0
Heads:								
Male	166	164	3	12	70	69	5	5
Female	6	4	0	1	3	0	0	0
Wives	162	152	3	14	135	0	0	0
Children:								
Sons	101	99	0	10	85	4	0	0
Daughters	95	90	0	4	86	0	0	0
Other Persons:								
Male	13	11	1	0	8	2	0	0
Female	22	15	1	1	13	0	0	0

*Includes individuals who reported approximately equal amount of time spent at chopping and picking.

males who did farmwork. Fifty-nine percent of the males and 91 percent of the female farmworkers reported approximately equal amounts of time spent at chopping and picking cotton, while 8 percent of both males and females had cotton picking as their major type of farmwork, compared with only 2 percent who mainly chopped cotton.

Male household heads were the family members most frequently reported as having the more highly skilled type of farmwork as their major activity during the preceding year. Sixty-nine of the 75 individuals who had tractor driving as their major activity and all the mechanics were heads of households.

EMPLOYMENT OF WORKERS

Procedures were developed to determine the number of days worked during 1957 by each person 10 years old and over. In regard to farm wage work and nonfarm employment, each respondent reported the number of days worked by each member of the household. Days of work done on family crops by sharecroppers and members of the sharecropper family presented a more difficult problem. Respondents had less identifiable bases on which to make a statement of days worked by each member of the household on the "sharecrop." A special procedure was used for estimating days of work on the sharecrop.

Respondents from families with sharecrops were asked to give the number of acres chopped, the yield per acre, and the pounds or bales of cotton picked by hand. Each respondent from a cropper family was asked also to estimate the percentage of the total amount of work on the crop that had been done by each member of the household. Data were available at the Delta Branch Experiment Station on the amount of labor required to produce a crop in the Delta under different levels of technology. From these, total man-hour equivalents were computed for each sharecrop. Total man-hours for the crop were divided between the members of the household according to the percentage estimates made by the respondent. This procedure provided the number of days of farm work done on the sharecrop by each member of the household during the previous year.

Total Days Worked Per Person

An average figure for number of days of employment during the last year is not too meaningful for a labor force of the kind sampled. For example, school children and housewives were not in the labor market for a major part of the year. Therefore, the number of days worked must be related to major activity, age, sex, and family status.

When employment data for workers who were not mainly in the labor force during the last year are excluded, workers who spent most of their time in the labor force are shown to have worked an average of 91 days (Table 13). School youth who worked averaged 65 days and housewives 67 days compared with an average of 96 days for croppers, 87 days for farm wage workers, and 78 days for unpaid family workers.

A clearer picture of the employment of the resident labor force can be obtained when individuals are divided into groups according to sex and family status. On this basis of classification, male heads of households worked an average of 98 days in the last year and the female heads of households who worked averaged 112 days. Sons and sons-in-law averaged 71 days and other males averaged 85 days compared with 68 days for wives, 63 days for daughters and daughters-in-law and 62 days for other females.

Many difficulties are encountered in attempting to arrive at norms for full or adequate employment as contrasted with underemployment or partial employment.[11] Partial employment or underempolyment is not entirely a matter of days worked. It is present also when a worker receives substandard returns per unit of work because of lack of skill or ability. Hence, in the study reported underemployment or partial unemployment is discussed in general terms only.[12]

Of the individuals who were mainly in the labor market, 30 percent worked less than 75 days, 38 percent from 75 to 100 days, 27 percent from 100 to 200 days, and 5 percent 200 or more days during 1957 (Table 13). Almost three-fourths of the group of individuals who were not in the labor market during most of 1957 had less than 75 days of employment.

In general, the head of the household is the breadwinner. As might be expected a greater proportion of these individuals worked 100 days or more during 1957 than did other household members.

Days of Farmwork Per Person

The importance of age as related to days of farmwork is shown in Table 14. Males age 10 to 13 averaged only 62 days of farmwork compared with an average of 83 days for males in the age group 14 to 24, 99 days for those 25 to 64 years old and only 89 days for males 65 years old and over. But

Table 13. Distribution of employed persons by number of days worked, chief activity, sex, and household status, survey plantations, Delta Area, Mississippi, 1957.

Characteristics of workers	Persons 10 years of age and over	Unemployed		Workers						
					Number of days worked					Av. days worked**
				Total*	1 to 49	50 to 74	75 to 99	100 to 199	200 or more	
	No.	No.	Pct.	No.	PERCENT					No.
All workers	565	28	5	526	13	40	30	14	3	78
Mainly in labor force	248	0	0	245	5	25	38	27	5	91
Farmwork***										
Cropper	55	0	0	55	2	16	40	40	2	96
Wage worker	150	0	0	147	6	24	39	25	6	87
Unpaid family worker	39	0	0	39	3	46	31	20	0	78
Nonfarm work	4	0	0	4	0	0	0	25	75	284
Mainly not in in labor force	317	28	9	281	21	52	24	3	****	66
Going to school	144	8	6	130	20	61	15	3	1	65
Keeping house	159	7	4	150	21	45	31	3	0	67
Retired or unable to work	14	13	93	1	100	0	0	0	0	12
Male	280	7	2	269	7	33	34	22	4	88
Head	166	2	1	162	3	19	41	33	4	98
Sons [5]	101	3	3	96	14	57	23	4	2	71
Other	13	2	15	11	9	36	37	9	9	85
Female	285	21	7	257	19	47	26	7	1	67
Head [6]	6	1	17	3	0	40	0	40	20	112
Wives	162	8	5	154	20	40	32	7	1	68
Daughters [7]	95	5	5	85	20	57	16	6	1	63
Other	22	7	32	15	20	60	20	0	0	62

*Nine persons did not report.
**Average only for those who worked.
***Includes 1 tenant.
****Less than 0.05 percent.
[5] Includes sons-in-law.
[6] Includes both single women living by themselves and wives whose husbands had died, or who were divorced.
[7] Includes daughters-in-law.

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[11] For a discussion of some of the difficulties, see: "The Meaning and Measurement of Partial and Disquised Unemployment" by Louis J. Ducoff and Margaret J. Hagood, in **The Measurement and Behavior of Unemployment**, Princeton University Press. Princeton, N. J., 1957.

[12] Examples of other studies in which the same technique was used are: **Employment and Underemployment of Rural People in The Ozarks** by W. H. Metzler and J. L. Charlton, Ark. Agr. Exp. Sta. Bul. 604, Nov. 1958 and **Employment and Underemployment of Negro Manpower in Calvert County, Maryland** by N. L. LeRay and W. C. Rohrer, Md. Agr. Exp. Sta. Bul. 467. March 1956. For additional data on employment of Mississippi farm labor see **Survey of Farm Labor in Mississippi** by D. A. Fisher and J. M. Koepper, U. S., A. M. S., 1958.

females aged 10 to 13 averaged only 53 days of farmwork compared with an average of 67 days for the age group 14 to 24, 70 days for those 25 to 64 years old, and only 56 for females 65 years old and over.

Eighty-four percent of the farmworkers had less than 100 days of farmwork during 1957 (Table 15). Workers with 100 days or more of farmwork included 37 percent of the tractor drivers, 80 percent of the mechanics, but only about 12 percent of those who had cotton chopping and picking as their major type of farmwork during 1957.

These figures indicate that in terms of total days worked, there is a source of labor on large plantations in the Delta area available for additional employment. This does not mean that there is a labor surplus for cotton production. As mentioned earlier, cotton production has peaks of high hand-labor requirements during chopping and picking that cannot be met by the resident labor force. However, the hand-labor requirements for cotton production are seasonal and do not afford opportunity for full employment of the plantation labor force.

Table 14. Days of farmwork as related to age and sex of workers, survey plantations, Delta Area, Mississippi, 1957.

Sex and age (in years)	Workers reported		Persons who worked					Average days worked
			1 - 49 days	50 - 74 days	75 - 99 days	100 - 199 days	200 or more days	
	Number	Percent	PERCENT					Number
All farm workers*	523	100	14	40	30	14	2	77
Male	269	100	8	33	34	22	3	88
10 - 13	38	100	21	58	21	0	0	62
14 - 24	84	100	7	46	31	12	4	83
25 - 64	135	100	4	19	40	33	4	99
65 and over	12	100	17	17	33	33	0	89
Female	254	100	20	48	26	6	0	66
10 - 13	37	100	33	59	8	0	0	53
14 - 24	82	100	15	53	27	5	0	67
25 - 64	131	100	18	42	31	9	0	70
65 and over	4	100	50	25	25	0	0	56

*Twelve persons did not report.

Table 15. Days of farmwork as related to the major type of farmwork, survey plantations, Delta Area, Mississippi, 1957.

Major type of farmwork	Workers reported	Percentage of workers who worked					Average days worked
		1 - 49 days	50 - 74 days	75 - 99 days	100 - 199 days	200 or more days	
	Number	PERCENT					Number
All workers*	523	13	41	30	14	2	77
Cotton:							
Chopping	8	50	38	12	0	0	50
Picking	41	39	29	20	10	2	62
Chopping and picking**	391	12	45	31	12	0	74
Tractor driver	73	3	27	33	33	4	95
Mechanic	5	0	0	20	40	40	162
Other	5	0	40	20	0	40	88

*Twelve persons did not report.

**Includes individuals who reported approximately equal amount of time spent at chopping and picking cotton.

INCOMES OF HOUSEHOLDS AND OF WORKERS

Income of plantation worker households cannot be measured exactly. There are many intangible factors, largely in the form of perquisites, that are difficult to measure. The large plantation is a social as well as an economic organization. Plantation operators often "stand for" their workers in legal difficulties. Frequently they give aid to workers' churches and contribute supplies and equipment for social activities. Many Negroes on cotton plantations have a philosophy of accepting things as they are. They may be "down on their luck," but they never lose faith that they will be provided for. Experience has shown them that in the Delta they can "get by." This may be one of the reasons why many of them stay in the area and the factor that brings migrants back from industrial areas during recessions.

Table 16. Distribution total cash income by households, survey plantations, Delta Area, Mississippi, 1957.

Income group*	Total households reporting		Average cash income per household
	Number	Percent	Dollars
Under $400	14	8	294
$400 - $799	76	44	583
$800 - $1,199	57	33	907
$1,200 - $1,599	15	9	1,497
$1,600 - $1,999	4	2	1,710
$2,000 - $2,399	1	1	2,018
$2,400 - $2,799	2	1	2,460
$2,800 or more	3	2	3,011
Total	172	100	845

*Includes cash income from farm, nonfarm, and nonwork sources.

The plantation family is provided with a house and the privilege of cutting wood for heating and cooking. Many plantation families also make extensive use of fish and game, which are available for little or no cash expense. Some plantation operators provide hospitalization coverage or pay their workers' doctor bills. In addition, 95 percent of the plantation households studied reported receiving "commodities"[13] in 1957.

The data on household incomes include no estimate of the value of goods and services furnished resident households by plantation operators and the community. These goods and services would need to be taken into account in any comparisons between the survey group and town residents in the Delta or groups in other parts of the Nation.

Household Incomes

Average cash income for all plantation households surveyed was $845 in 1957 (Table 16). This includes net income from all sources including the sharecrop, and earnings from farm wage work, nonfarm work, and nonwork income. More than half of the households reported cash incomes of less than $800. Only 10, or 6 percent,

Table 17. Persons and number of workers per household by income groups, survey plantations, Delta Area, Mississippi.

Income group*	Households		Persons per household	Workers per household
	Number	Percent	Number	Number
All households	172	100	5.5	3.1
Under $800	90	52	4.8	2.6
Under $400	14	8	4.6	2.5
$400 - $799	76	44	4.8	2.6
$800 - $1,600	72	42	5.9	3.4
$800 - $1,199	57	33	5.9	3.3
$1,200 - $1,599	15	9	5.9	4.0
$1,600 or more	10	6	9.3	5.1
$1,600 - $1,999	4	2	8.8	4.8
$2,000 - $2,399	1	1	7.0	5.0
$2,400 - $2,799	2	1	12.5	5.5
$2,800 or more	3	2	8.7	5.3

*Includes cash income from farm, nonfarm and nonwork sources.

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[13] Surplus agricultural products distributed by local welfare agencies.

of the households had cash incomes of $1,600 or more.

Households with the larger cash incomes tended to be larger and have more workers than those with lower incomes (Table 17). Households with incomes under $800 averaged 4.8 individuals and 2.6 workers per household; those with incomes between $800 and $1,600 averaged 5.9 individuals and 3.4 workers; while households with incomes above $1,600 averaged 9.3 individuals and 5.1 workers.

Households reporting the major types of nonwork income are shown in Table 18. Of the 172 households studied, 8 percent reported welfare payments, 5 Social Security payments, and 2 other types of nonwork income. Most of the nonwork income was received by households in the $800 to $1,599 household income group. The households reporting nonwork income received an average of $550 from nonwork sources.

Household income from farmwork by chief source of farm income is shown in Table 19. During 1957, 59 percent of the households had no sharecrop and received all their farm income from farm wage work, 28 percent received income from both the family sharecrop and farm wage work, and 13 percent received all their farm income from the family sharecrop.

Household incomes from farmwork averaged $811. The highest average income, $916, was reported by the group that combined farm wage work with sharecropping but depended primarily on farm wake work. In contrast, the lowest average income, $690, was reported by the group that did no farm wage work but depended on the sharecrop as the only source of farm income.

Individual Earnings From Farm Wage Work

It is difficult to determine income data for persons living on large plantations in the Delta area of Mississippi. Household incomes from sharecrop might be divided between workers in the household on the basis used to determine the number of days of work. However, this procedure would not provide an accurate picture of individual income, because perquisites and most income from nonwork sources are supplied on a household rather than an individual basis.

Sex, age, and household status were important factors affecting earnings from farm wage work. Earnings of females, school age males, and males above 65 years of age were considerably less than those of males in the more productive age group (Table 20). Thirty-five percent of the males and 72 per-

Table 19. Household income from farmwork by chief source of farm income, survey plantations, Delta Area, Mississippi, 1957.

Chief source of farm income	Households	Average farm income per household
	Number	Dollars
Farm wage work only	101	812
Farm wage work and sharecropping:		
Mainly farm wage work	24	916
Mainly sharecropping	25	816
Sharecropping only	22	690
All households	172	811

Table 18. Distribution of households by type of nonwork income and income group, survey plantations, Delta Area, Mississippi, 1957.

Income group*	Survey households	Households with nonwork income** All	Welfare	Social Security	Other
		NUMBER			
Under $800	90	3	2	0	1
$800 - $1,599	72	11	5	5	1
$1,600 or more	10	1	1	0	0
Total	172	15	8	5	2
		DOLLARS			
Average		550	425	517	592

*Includes cash income from farm, nonfarm, and nonwork sources.

**Some households had more than one type of nonwork income.

cent of the females earned less than $200 at farm wage work during 1957.

Family status had an important influence on earnings from farm wage work. Male heads of households with an average of $302 reported the highest average earnings from farm wage work. This is primarily because male heads of households tended to be employed in the more skilled activities on a full-time basis and not as casual workers during the chopping and picking season, as is the case with many wives and children.

Table 20. Distribution of resident plantation workers by specified amounts earned at farm wage work by sex, age, and family status, survey plantations, Delta Area, Mississippi, 1957.

Sex, age, and family status	Persons with farm wage work income		Percentage of persons with earnings							Average earnings per worker
			Under $200	$200 to $299	$300 to $399	$400 to $499	$500 to $599	$600 to $699	$700 and over	
	No.	Pct.	PERCENT							Dollars
All farm wage workers*	409	100	52	20	10	8	5	1	4	196
Male	224	100	35	18	16	13	9	2	7	255
10 - 13	24	100	71	25	4	0	0	0	0	121
14 - 24	75	100	45	26	11	7	7	0	4	221
25 - 64	119	100	20	13	20	20	12	4	11	303
65 and over	6	100	50	0	33	17	0	0	0	250
Female	185	100	72	22	4	1	0	1	0	124
10 - 13	24	100	88	12	0	0	0	0	0	108
14 - 24	60	100	69	23	8	0	0	0	0	119
25 - 64	99	100	70	24	3	2	0	1	0	130
65 and over	2	100	100	0	0	0	0	0	0	150
Male	224	100	35	18	16	13	9	2	7	255
Heads	140	100	20	12	20	21	13	4	10	302
Sons	76	100	62	29	8	0	0	0	1	176
Other males	8	100	38	25	13	12	0	0	12	213
Female	185	100	72	22	4	1	0	1	0	124
Heads	3	100	67	33	0	0	0	0	0	83
Wives	114	100	69	26	4	1	0	0	0	119
Daughters	56	100	80	16	0	2	0	2	0	130
Other	12	100	67	8	25	0	0	0	0	150

*Data were not available for 36 individuals.

BULLETIN 607 DECEMBER 1960

Heater Hood Improves Circulation In

Plastic Greenhouse Studies In Mississippi Delta

	Without Hoods	With Hoods	Ht.
Temp.	106°	93°	96"
Hum.	27%	43%	
Temp.	98°	86°	58"
Hum.	30%	57%	
Temp.		81°	38"
Hum.		60%	
Temp.	59°	70°	18"
Hum.	97%	81%	

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

JUN 17 1961

On cover. Temperature and humidity readings were recorded at different levels in the house. Note from the chart how circulation induced by the hoods improved conditions throughout the house.

HEATER HOOD IMPROVES CIRCULATION IN PLASTIC GREENHOUSE STUDIES IN MISSISSIPPI DELTA

By W. W. WATSON and J. A. RILEY[1]

Good circulation of air is important in greenhouses. Without it, plants near ground level are cold and damp while heat is wasted at the top of the house.

This report describes plastic greenhouse studies at the Delta Branch Experiment Station, where simply constructed hoods under the heaters induced circulation and corrected undesirable temperature and humidity conditions.

Commercial House Used

The house used at the Delta Station is one of several models manufactured commercially. Its dimensions are 20 by 48 feet. The framework is covered by one sheet of plastic which is held in place by cables that lie in a formed groove on top of the ribs of the aluminum framework. These cables can be tightened for the needed tension to hold the plastic in place and they distribute tension over the entire rib, which is desirable. They are very convenient and time saving in covering the framework with plastic.

The end framework is installed to meet the desires and needs of the individual owner. Plastic on the ends is held in place by wood battens nailed to the wooden framework.

Plastics of various kinds and thicknesses can be used. For this study clear polyethylene plastic, .004 inches thick, was used as a top cover. Clear poly vinyl, .004 inches thick, was used on the end framework. Both of these were entirely satisfactory under the conditions and for time they were used.

Heating and Ventilating System

Heating and ventilating systems were selected to make the house as nearly automatic as possible and of adequate size for the normal extreme weather conditions in the Delta. One heater was installed in each end of the house. In cases of mechanical failure of one heater the other would be sufficient to prevent destruction of the crop by low temperatures. Each heater is individually controlled by a thermostat. A single exhaust fan equipped with an automatic louver is located in one end of the house. On the opposite end, another automatic louver

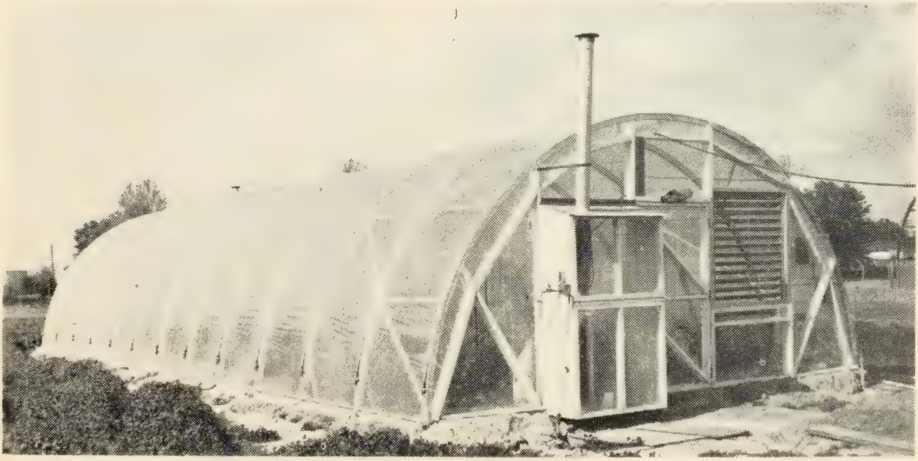

Figure 1. Plastic greenhouse used in Delta study.

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provides an entrance for outside air while the fan is operating. This fan is also controlled by a thermostat and comes on at a selected point above which the heaters have ceased to function.

Figures 1 and 2 show a view of the house and a close-up of the bays in which the heaters were installed. The bays were added to conserve space inside the house and to provide locations outside the house for gas controls for the heaters. This was done to prevent gas from entering the house in the event of a gas leak.

Tomato Crop Grown

A tomato crop was grown in the house to study varieties and production practices involved in producing high quality vine ripened tomato fruits during the winter months.

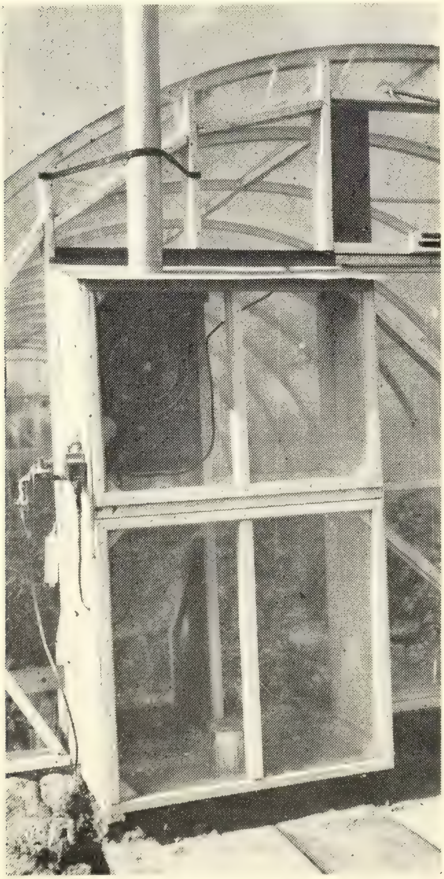


Figure 2. Close-up of bay in which heater was installed.

Fifteen plants of ten varieties were compared. The 150 plants were grown in ground beds and trained to single stems. They were set in the house in early March and fruited through late June. The late setting was due to difficulties in completing the house. Table 1 lists the varieties grown and the yields.

Since the purpose of a greenhouse is to produce a favorable climate on the inside, when it is lacking outside, detailed temperature and humidity observations were taken in the house.

Hood Installed

After a few days operation, it was apparent that the plant zone became too cold and damp at night even though two heaters, each rated 60,000 BTU output, should have been adequate for the size of the house and the prevailing climate.

To reduce these unfavorable extremes a hood which would induce air circulation was installed under each heater. As air in the heaters became warm and was forced out, cool air near the ground was pulled up the hoods. This in turn was heated, forced out into the house, cooled, settled to the ground, and returned to the hood thus establishing a cycle that tended to make for much less stratification in the house. This simply-constructed hood induced circulation that could have been achieved by fans only after considerable cost with re-occurring upkeeps costs.

Weather measurements in this report are grouped before and after March 24, the dates the hoods were installed.

During both periods, horizontal variation, from end to end of the house was very minor. Temperature varied only 2 to 3 degrees and relative humidity only about 5 percent. Vertical variation was quite a different story however. Table

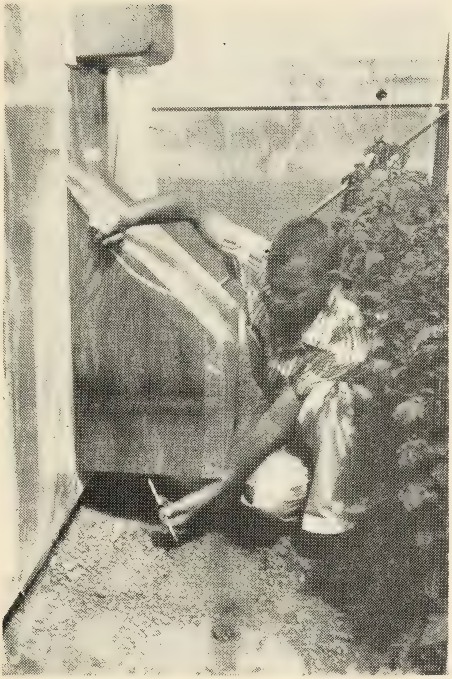


Figure 3. This hood was added to induce air circulation from a low level inside the house. Before this alteration, the bay inside the house was completely open, which meant that air could be pulled from any level to be forced through the heater. After alteration, air was drawn from the coldest level in the house.

2 and 3 show temperature and relative humidity measurements.

These measurements were made by locating recording (hygrothermograph) units at different levels in the house. During the period March 17 through March 23 recordings were made at three levels: 18 inches above ground, 58 inches above ground, and 96 inches above ground. This top unit was approximately 24 inches below the top of the house. During the period after March 23, recordings were made at four levels: 18 inches, 38 inches, 58 inches, and 96 inches.

Without Hoods

Without the circulation hoods, minimum nightly temperature averaged a little over 53° F. at 18 inches above the ground, 93.5° F. at 58 inches above the ground and a little over 100° F. at 96 inches. Tomato plants suffered from the cold night-time temperatures. It was physically impossible to keep the lower part of the house in the desirable 60- to 70-degree temperature range. Even if it had been possible, such a temperature stratification would be very uneconomical, as much of the heat went to the top of the house where it was wasted.

Due to the extreme temperature differences from the inside to the outside, the top heat may do actual damage to the plastic cover. Also, since the radiating power of air is approximately equal to the fourth power of the temperature, the

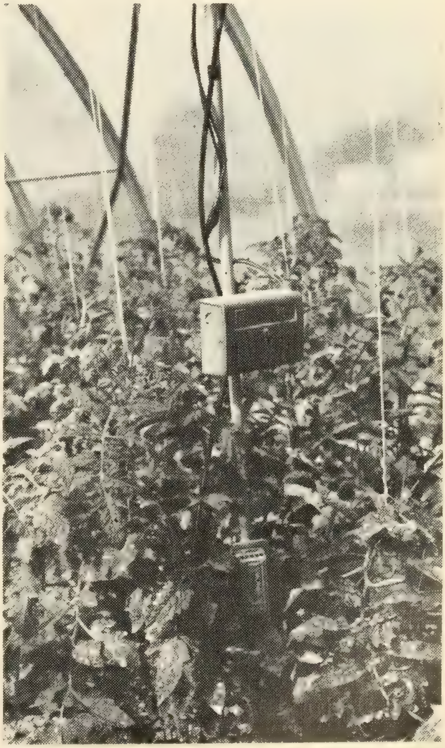


Figure 4. Heater and thermostats in plant zone.

hot air near the top loses heat much faster than if it were cooler.

Relative humidity, which in a greenhouse is largely controlled by temperature, also showed extreme vertical variation. During the March 17-March 23 period the humidity at the 18-inch level was 100 percent for 88 percent of the time during the hours from 6 p.m. to 6 a.m. During the later hours of midnight to 6 a.m., the air was saturated 96 percent of the time. This means that foliage was wet with dew most of the night. At the 58-inch level the relative humidity averaged only 30 percent while at the upper level it averaged a fairly steady 27 percent.

With Hoods

After the circulating hoods were installed, the 18-inch level minimum temperature was increased 13°F. (See Table 2).

The minimum temperature at the 58 inch level showed decrease of 16 degrees

Table 1. Yield of tomatoes in plastic greenhouse, Stoneville, Miss.

Variety	Pounds No. 1 fruit per plant	Pounds other fruit per plant	Total pounds per plant	Average size No. 1 fruit in ounces
Tuckcross 0	10.3	.9	11.3	5.4
Hybrid 375	9.8	.4	10.3	5.8
Tuckcross V	9.7	.7	10.5	5.1
Hybrid 390	8.2	.3	8.6	5.3
Ohio WR Globe	8.2	.7	8.9	6.0
Tuckcross M	8.2	.9	9.2	5.3
Ohio WR 7	7.0	.4	7.5	6.3
Big Boy	6.7	.2	7.0	7.2
Mocross Supreme	5.7	.5	6.3	5.2
Globelle	4.7	.3	5.1	5.0

Table 2. Temperature in degrees Fahrenheit in plastic greenhouse, Stoneville, Mississippi, March 17 - April 1, 1960, during hours of midnight to 7 a.m.

Date	Outside minimum	Height in inches — maximum-minimum			
		18	38	58	96
		Without circulation hood			
March 17-18	29	56-48		102-95	106-101
18-19	34	62-54		104-98	112-106
19-20	32	56-52		109-92	115-99
20-21	31	62-51		99-87	108-93
21-22	34	62-51		99-87	108-93
22-23	38	62-60		100-93	108-100
Average Maximum-Minimum	33.0	60.0/53.5		103.5/93.5	110.7/100.7
Range		6.5		10.0	10.0
Average		58.7		98.5	105.7
		With circulation hood			
March 23-24	42	73-65	87-74	96-76	106-82
24-25	37	76-67	90-78	98-85	105-92
25-26	38	74-67	89-76	96-79	105-84
26-27	44	76-70	91-77	97-79	104-84
27-28	53	78-69	92-78	98-80	106-84
28-29	59	79-71	91-76	98-79	108-83
29-30	51	74-67	88-76	96-78	106-85
30-31	40	70-62	87-73	92-75	102-81
31-April 1	49	67-59	79-65	84-66	95-69
Average Maximum-Minimum	45.9	74.1/66.3	88.2/74.8	95.0/77.4	104.1/82.7
Range		7.8	13.4	17.6	21.4
Average		70.2	81.5	86.2	93.4

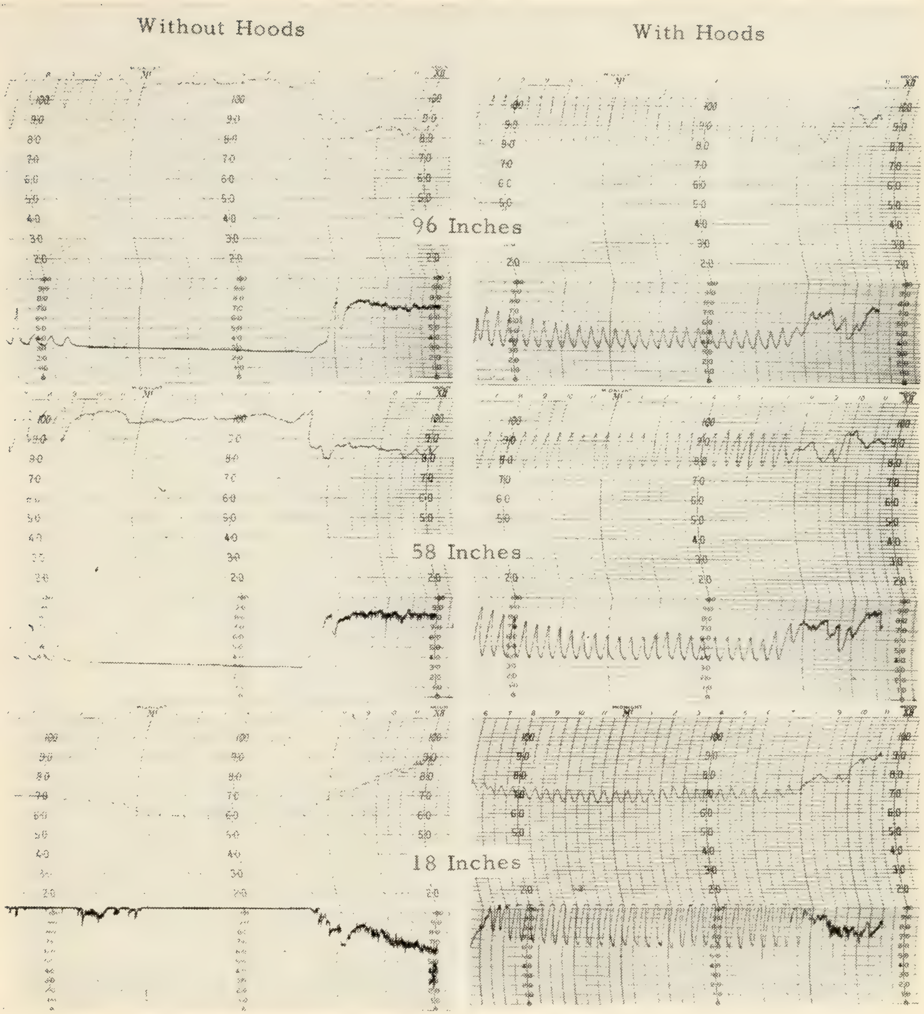


Figure 6. The top line in each chart is the temperature record and the lower line the humidity record for a given time in the greenhouse. Note how the hood corrected the cold, damp situation at the lower level and reduced the heat at the top. Oscillating lines at the right show that the heater came on frequently, got the temperature up to the thermostat setting, and cut off. Previously the heaters continued to operate, heating the top of the house while the bottom was cold.

while the highest instrument showed an average decrease of 18 degrees.

Mean temperatures showed similar changes. At 18 inches the temperature increased 11 degrees, at 58 inches and at the upper level, the temperature averaged 12 degrees lower.

Relative humidity observations also indicated much less stratification after the circulating hood was introduced. During the period 6 p.m. to 6 a.m., the air was saturated less than 15 percent of the time in contrast with 88 percent of the time before the circulator was installed. From midnight to 6 a.m., the air was saturated 20 percent of the time at 18 inches in comparison with 96 percent before. In the middle and upper parts of the house, the humidity became less extreme averaging 57.5 percent at 58 inches, and 43.5 percent at the 8-foot level. Both temperature and humidity observations indicate that the 38-inch level is more similar to the 58-inch level than the 18-inch level.

Unfortunately for purposes of comparison, the first period of observations had outside minimum temperature that averaged about 16°F. colder than did the latter period. This could possibly explain some of the warming effect at the lowest level of the house, but it certainly does not explain the reduction in temperature at the top of the house.

Hood Saved Fuel

Temperature and humidity recordings were made before and after alterations to induce circulation. Other than the fact that the period with the circulation hood shows considerable less variation from top to bottom, a very interesting feature is the oscillating wave line showing on both temperature and relative humidity records. These fluctuations are due to the thermostats cutting the heat on and off. The heaters stayed on for much longer periods during the nights with low outside temperatures before the circulation hood with a consequent larger consumption of fuel. Though it would be desirable to maintain a constant optimum temperature and humidity, this would entail much more expense of equipment and operating costs. The economical weather controls featured in this report seem to be adequate for the climate of the Mississippi Delta area and for the types of crops that are being grown, thus appear to offer a balance between facility and expense.

Table 3. Relative humidity in plastic greenhouse, Stoneville, Mississippi, March 17-April 1, 1960, during the hours of midnight to 6 a.m.

Date	Percent of time that relative humidity was 100% at 18"	Longest period in minutes that relative humidity was 100% at 18"	Maximum and minimum relative humidity			
			Height (inches)			
			18	38	58	96
Night of:			Without circulation hood			
March 17-18	100	360	100-100		31-28	30-26
18-19	100	358	100-98		33-29	30-26
19-20	100	350	100-84		29-24	28-22
20-21	80	240	100-92		32-30	30-27
21-22	100	360	100-100		35-32	31-27
22-23	99	270	100-94		31-26	26-24
Average Maximum-Minimum			100-95		32-28	29-25
Average	96	322	97.5		30.0	27.0
			With circulation hood			
March 23-24	13	5	100-58	78-34	67-37	58-33
24-25	0	0	85-60	43-33	47-36	37-31
25-26	5	4	100-65	68-37	59-38	52-34
26-27	20	10	100-66	90-36	77-39	62-36
27-28	40	10	100-67	100-40	100-41	78-38
28-29	40	12	100-65	99-39	90-41	76-36
29-30	25	10	100-70	88-39	78-38	71-34
30-31	10	10	100-71	86-40	70-40	58-36
31-April	30	18	100-66	100-38	94-40	78-38
Average Maximum-Minimum			98-65	84-37	76-39	53-34
Average	20	9	81.5	60.5	57.5	43.5

BULLETIN 608 DECEMBER 1960

GROWTH OF MISSISSIPPI COUNTIES and CITIES 1950 TO 1960

JUN 16 1961

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

HIGHLIGHTS OF MISSISSIPPI POPULATION

Mississippi's population, 1960: 2,178,141, a decrease of 0.03 percent since 1950.

Twenty-one of the 82 counties in the state increased in population.

County with the highest rate of increase: Jackson County, 76 percent.

County with the highest numerical increase: Hinds County, 44,881.

Congressional Districts 4 and 6 increased.

Large incorporated places (1,000 or more population) grew by 178,433.

One Hundred and eleven of the state's 124 incorporated places of 1,000 or more grew during the decade.

Gulf Coast area increased by 73,185.

Delta area lost 57,250.

Eighteen largest cities increased a total of 124,740.

GROWTH OF MISSISSIPPI COUNTIES AND CITIES 1950 TO 1960

By GEORGE L. WILBER and ELLEN BRYANT

Mississippi's total population has changed little since 1940. The natural increase that might be expected from a high birth rate has been offset by migration of people from the state.

There are, however, a number of important population changes taking place within the state. The average age of people in Mississippi is increasing. Their income and amount of schooling are also increasing. More people live in towns, fewer in rural areas. More live in the Gulf Coast counties and fewer in the Delta and the hills. More are engaged in manufacturing jobs, fewer in farming.

These changes, which affect agriculture as well as the entire economy of the State, become apparent when one studies 1960 census figures. As of April 1960, Mississippi's population numbered 2,178,141, a decrease of 0.03 percent from 1950. The full picture of population changes will not be drawn for another couple of years, after detailed census reports are out. But the figures on size of population do reflect changes in Mississippi's agriculture, and the changing role of agriculture in the State's social and economic life.

Differential Growth Trends

County Differences: About one quarter of Mississippi's counties gained populaton during the 1950's and half of these increased by 10 percent or more. Of the counties losing population, 38 lost at least 10 percent. Fifty-three of the 61 counties losing population in the 1950's also lost during the 1940's. A similar persistency is shown in growing counties where 17 grew both in the 1940's and 1950's.

Hinds County gained the most people during the 1950's with an increase of nearly 45,000. At the other extreme, Sunflower County showed the largest loss with a decrease of over 10,000.

Large Incorporated Places Grow: While many counties and large areas of the state lost population, cities were the exception. Mississippi's cities of 10,000 and over increased by about 20 percent.

In incorporated places of 1,000 or more population in 1960, a net increase of 178,433 people took place for the decade of the 1950's as compared with gains of 176,891 for the 1940's and 85,084 for the 1930's. A large majority, 111 out of 124, of the state's incorporated places of 1,000 or more gained population in the 1950's and 97 places had gains over both the past two decades.

All incorporated places of 5,000 and over in 1960 increased population.

Coastal Counties Increase: Nine of the ten counties along the Gulf Coast showed an increase between 1950 and 1960. As a whole they increased 73,185, about 30 percent. Numerically Harrison County led the way with an increase of 35,416 or 42.1 percent. However, percentagewise, Jackson County was first, its 24,121 increment representing a 76.8 percent increase, the highest rate of growth in any Mississippi County.

Most of the population expansion around the Gulf Coast is probably the result of in-migration rather than natural increase. The region has had a heavy influx of military personnel. Also, expanding industrial operations and the booming tourist industry have attracted thousands into the area.

Delta Counties Lose: Fifteen counties lost population in the 18-county area served by the Delta Council. The net loss for the area was 57,250 persons, or 9.4 percent. The Delta Area as a whole has lost population consistently since 1940. During the 1940's alone it lost 42,685 persons bringing the total net loss during the 20-year period to about 100,000 individuals. Warren and Washington counties were exceptions. Both have had a steady increase in inhabitants since 1930. In the 1930 depression decade widespread gains augmented the area's total population by nearly five percent.

Urban Centers of Growth: The pattern of population loss which nearly blankets the state, except for the coastal area, is broken also by growth in scattered counties containing large and expanding industrial centers. Adams County with Natchez; Lauderdale with Meridian; the Lowndes - Oktibbeha - and - Clay area containing Columbus, Starkville, and West Point; Lee County with Tupelo; and Washington with Greenville all contribute to Mississippi's uneven pattern of growth.

Table 1. Population change of highest income and lowest income counties in Mississippi, 1950-1960.

County	Population[1]		Median family income, 1949[2]
	Number, 1960	Percent change, 1950-1960	
Highest-Income Ranking Counties			Dollars
Hinds	187,045	31.6	2,293
Harrison	119,489	42.1	2,291
Jackson	55,522	76.8	2,131
Adams	37,730	17.0	2,128
Forrest	52,722	17.0	1,990
Warren	42,206	6.5	1,835
Lauderdale	67,119	4.6	1,835
Jones	59,542	4.0	1,657
Pike	35,063	0.2	1,592
Pearl River	22,411	8.6	1,581
Lowest-Income Ranking Counties			
Tallahatchie	24,081	—21.0	690
Humphreys	19,093	—17.4	672
Sharkey	10,738	—16.8	664
Tate	18,138	0.7	650
De Soto	23,891	— 2.9	643
Issaquena	3,576	—28.0	627
Kemper	12,277	—22.8	613
Marshall	24,503	— 2.4	580
Holmes	27,096	—18.6	553
Noxubee	16,826	—16.0	549

[1] Bureau of the Census, 1960 Census of Population, Advance Reports, Final Population Counts, PC(A1)-26, November 7, 1960.

[2] Bureau of the Census, **City and County Data Book,** 1956, Col. 15, pp. 154 and 162.

The largest nucleus of growing counties in the state consists of Warren, Hinds, and Rankin counties, which embrace both metropolitan Jackson and urban Vicksburg. Jones and Forrest Counties containing Laurel and Hattiesburg, respectively, are two more areas of growth. Almost all the counties which showed substantial growth have cities with at least 25,000 population in 1960. A few cities approach 50,000 and Jackson is close to 150,000.

The eighteen Misissippi cities of 10,000 or more population in 1960 together marked up a growth of 124,740 during the 1950's. Moreover, these eighteen largest cities grew continuously since 1930, with the exception of McComb which had a slight loss in the decade of the 1930's.

Factors of Population Change

An attempt was made to determine the relationship of county population growth to certain variables. Groups of counties ranked "high" on particular factors were compared as to their growth rates. Data for these variables were obtained from 1950 Census figures, since 1960 reports on population characteristics are not yet available. The variables were: (1) Percent of population with urban residences, (2) Percent employed in agriculture, (3) Percent employed in manufacturing, and (4) Median family income in 1949.

Urban vs Rural: The predominant trend in the most urban counties is growth and in those most rural toward a contracting population. Counties ranked highest on the rurality scale also had the highest percents of population loss. On the basis of this data, it seems reasonable to predict that any county with a high proportion of farm people among its residents will be subject to out-migration.

The degree of urbanization among the fifteen top-ranking urban counties covers a relatively wide range, with from 34.9

to 82.7 percent of the populations having urban residences in 1950. But 12 of 15 most urban counties gained population in the 1950's.

Industrialization: Counties were ranked according to proportion of their labor force employed in manufacturing in 1950, and the top fifteen were checked for population loss and gain. No consistent pattern of population growth was found, but this result is not necessarily illogical. Existing factories would not necessarily attract new residents, unless there were sufficient expansion to absorb a larger labor force.

Income: The ten counties with the highest and the ten counties with the lowest incomes in 1949 were cross tabulated with percent gain or loss of inhabitants. High median family incomes are associated with population increases; low ones with diminishing populatons. The extremely low average incomes of the ten counties at the bottom of the scale indi-

Table 2. Population Mississippi counties, 1950 and 1960.

County	Population	
	1960[1]	1950[2]
Adams	37,730	32,256
Alcorn	25,282	27,158
Amite	15,573	19,261
Attala	21,335	26,652
Benton	7,723	8,793
Bolivar	54,464	63,004
Calhoun	15,941	18,369
Carroll	11,177	15,499
Chickasaw	16,891	18,951
Choctaw	8,423	11,009
Claiborne	10,845	11,944
Clarke	16,493	19,362
Clay	18,933	17,757
Coahoma	46,212	49,361
Copiah	27,051	30,493
Covington	13,637	16,036
De Soto	23,891	24,599
Forrest	52,722	45,055
Franklin	9,286	10,929
George	11,098	10,012
Greene	8,366	8,215
Grenada	18,409	18,830
Hancock	14,039	11,891
Harrison	119,489	84,073
Hinds	187,045	142,164
Holmes	27,096	33,301
Humphreys	19,093	23,115
Issaquena	3,576	4,966
Itawamba	15,080	17,216
Jackson	55,522	31,401
Jasper	16,909	18,912
Jefferson	10,142	11,306
Jefferson Davis	13,540	15,500
Jones	59,542	57,235
Kemper	12,277	15,893
Lafayette	21,355	22.798
Lamar	13,675	13,225
Lauderdale	67,119	64,171
Lawrence	10,215	12,639
Leake	18,660	21,610
Lee	40,589	38,237
Leflore	47,142	51,813
Lincoln	26,759	27,899
Lowndes	46,639	37,852
Madison	32,904	33,860
Marion	23,293	23,967
Marshall	24,503	25,106
Monroe	33,953	36,543
Montgomery	13,320	14,470
Neshoba	20,927	25,730
Newton	19,517	22,681
Noxubee	16,826	20,022
Oktibbeha	26,175	24,569
Panola	28,791	31,271
Pearl River	22,411	20,641
Perry	8,745	9,108
Pike	35,063	35,137
Pontotoc	17,232	19,994
Prentiss	17,949	19,810
Quitman	21,019	25,885
Rankin	34,322	28,881
Scott	21,187	21,681
Sharkey	10,738	12,903
Simpson	20,454	21,819
Smith	14,303	16,740
Stone	7,013	6,264
Sunflower	45,750	56,031
Tallahatchie	24,081	30,486
Tate	18,138	18,011
Tippah	15,093	17,522
Tishomingo	13,889	15,544
Tunica	16,826	21,664
Union	18,904	20,262
Walthall	13,512	15,563
Warren	42,206	39,616
Washington	78,638	70,504
Wayne	16,258	17,010
Webster	10,580	11,607
Wilkinson	13,235	14,116
Winston	19,246	22,231
Yalobusha	12,502	15,191
Yazoo	31,653	35,712
State Total	2,178,141	2,178,914

[1] Bureau of the Census, 1960 Census of Population, Advance Reports, Final Population Counts, PC(A1)-26, November 7, 1960.

[2] Bureau of the Census, **1950 Census of the Population,** Vol. II, Part 24. Table 12.

cate a great deal of underemployment. Rates of out-migration should be high for these counties. Aside from economic development within the regions, outmigration is the only solution which can relieve such areas.

Table 3. Population of incorporated places of 1,000 or more persons, 1960.

Incorporated place	Population 1960[1]	Population 1950[2]	Percent change 1950-1960
Aberdeen	6,450	5,290	22.0
Ackerman	1,382	1,463	— 5.5
Amory	6,474	4,990	30.0
Baldwyn	2,023	1,567	29.0
Batesville	3,284	2,463	33.0
Bay St. Louis	5,073	4,621	9.8
Bay Springs	1,544	1,302	18.6
Belzoni	4,142	4,071	1.7
Biloxi	44,053	37,425	17.7
Booneville	3,480	3,295	5.6
Brandon	2,139	1,827	17.1
Brookhaven	9,885	7,801	26.7
Bruce	1,698	1,719	— 1.2
Bude	1,185	1,195	— .8
Calhoun City	1,714	1,319	29.9
Canton	9,707	7,048	37.7
Carthage	2,442	1,925	26.9
Centreville	1,229	2,025	—39.3
Charleston	2,528	2,629	— 3.9
Clarksdale	21,105	16,539	27.6
Cleveland	10,172	6,747	50.8
Clinton	3,438	2,255	52.5
Coldwater	1,264	949	33.2
Collins	1,537	1,293	18.9
Columbia	7,117	6,124	16.2
Columbus	24,771	17,172	44.3
Corinth	11,453	9,785	17.0
Crenshaw	1,382	740	86.8
Crystal Springs	4,496	3,676	22.3
Decatur	1,340	1,225	9.4
Drew	2,143	1,681	27.5
Durant	2,617	2,311	13.2
Edwards	1,206	1,002	20.4
Ellisville	4,592	3,579	28.3
Eupora	1,468	1,338	9.7
Fayette	1,626	1,498	8.5
Forest	3,917	2,874	36.3
Friars Point	1,029	916	12.3
Fulton	1,706	1,343	27.0
Gloster	1,369	1,467	— 6.7
Greenville	41,502	29,936	38.9
Greenwood	20,436	18,061	13.1
Grenada	7,914	7,388	7.1
Gulfport	30,204	22,659	33.3
Hattiesburg	34,989	29,474	18.7
Hazlehurst	3,400	3,397	.1
Heidelberg	1,049	863	21.6
Hernando	1,898	1,206	57.4
Hollandale	2,646	2,346	12.8
Holly Springs	5,621	3,276	71.6
Houston	2,577	1,664	54.9
Indianola	6,714	4,369	53.4
Inverness	1,039	1,010	2.9
Itta Bena	1,914	1,725	11.0
Iuka	2,010	1,527	31.6
Jackson	144,422	98,271	47.0
Kosciusko	6,800	6,753	.7
Lambert	1,181	1,023	15.5
Laurel	27,889	25,038	11.4
Leakesville	1,014	893	13.5
Leland	6,295	4,736	32.9
Lexington	2,839	3,198	—11.2
Long Beach	4,770	2,703	76.5
Louisville	5,066	5,282	— 4.1
Lucedale	1,977	1,631	21.2
Lumberton	2,108	1,803	16.9
McComb	12,020	10,401	15.6
Macon	2,432	2,241	8.5
Magee	2,039	1,738	17.3
Magnolia	2,083	1,984	5.0
Marks	2,572	2,209	16.4
Mendenhall	1,946	1,539	26.4
Meridian	49,374	41,893	17.9
Monticello	1,432	1,382	3.6
Moorhead	1,754	1,749	.3
Morton	2,260	1,664	35.8
Moss Point	6,631	3,782	75.3
Mound Bayou	1,354	1,328	2.0
Natchez	23,791	22,740	4.6
Nettleton	1,389	1,204	15.4
New Albany	5,151	3,680	40.0
Newton	3,178	2,912	9.1
Ocean Springs	5,025	3,058	64.3
Okolona	2,622	2,167	21.0
Oxford	5,283	3,956	33.5
Pascagoula	17,139	10,805	58.6
Pass Christian	3,881	3,383	14.7
Pelahatchie	1,066	867	23.0
Philadelphia	5,017	4,472	12.2
Picayune	7,834	6,707	16.8
Pontotoc	2,108	1,596	32.1
Poplarville	2,136	1,852	15.3
Port Gibson	2,861	2,920	— 2.0
Prentiss	1,321	1,212	9.0
Purvis	1,614	1,270	27.1
Quitman	2,030	1,817	11.7
Raymond	1,381	1,259	9.7
Richton	1,089	1,158	— 6.0
Ripley	2,668	2,383	12.0
Rolling Fork	1,619	1,229	31.7
Rosedale	2,339	2,197	6.5
Ruleville	1,902	1,521	25.0
Sardis	2,098	1,913	9.7
Senatobia	3,259	2,108	54.6
Shaw	2,062	1,892	9.0
Shelby	2,384	2,148	11.0
Starkville	9,041	7,107	27.2
Summit	1,663	1,558	6.7
Taylorsville	1,132	1,116	1.4
Tunica	1,445	1,354	6.7

Tupelo	17,221	11,527	49.4
Tutwiler	912	939	— 2.9
Tylertown	1,532	1,331	15.1
Union	1,726	1,559	10.7
Vicksburg	29,130	27,948	4.2
Water Valley	3,206	3,213	—.2
Waveland	1,106	793	39.5
Waynesboro	3,892	3,442	13.1
Wesson	1,157	1,235	—6.3
West Point	8,550	6,432	32.9
Wiggins	1,591	1,436	10.8
Winona	4,282	3,441	24.4
Woodville	1,856	1,609	15.4
Yazoo City	11,236	9,746	15.3
Total	889,276	710,843	25.0

[1] Bureau of the Census, 1960 Census of Population, Advance Reports, Final Population Counts P C(A1)-26, November 7, 1960.

[2] Bureau of the Census, **1950 Census of the Population,** Vol. II, Part 24.

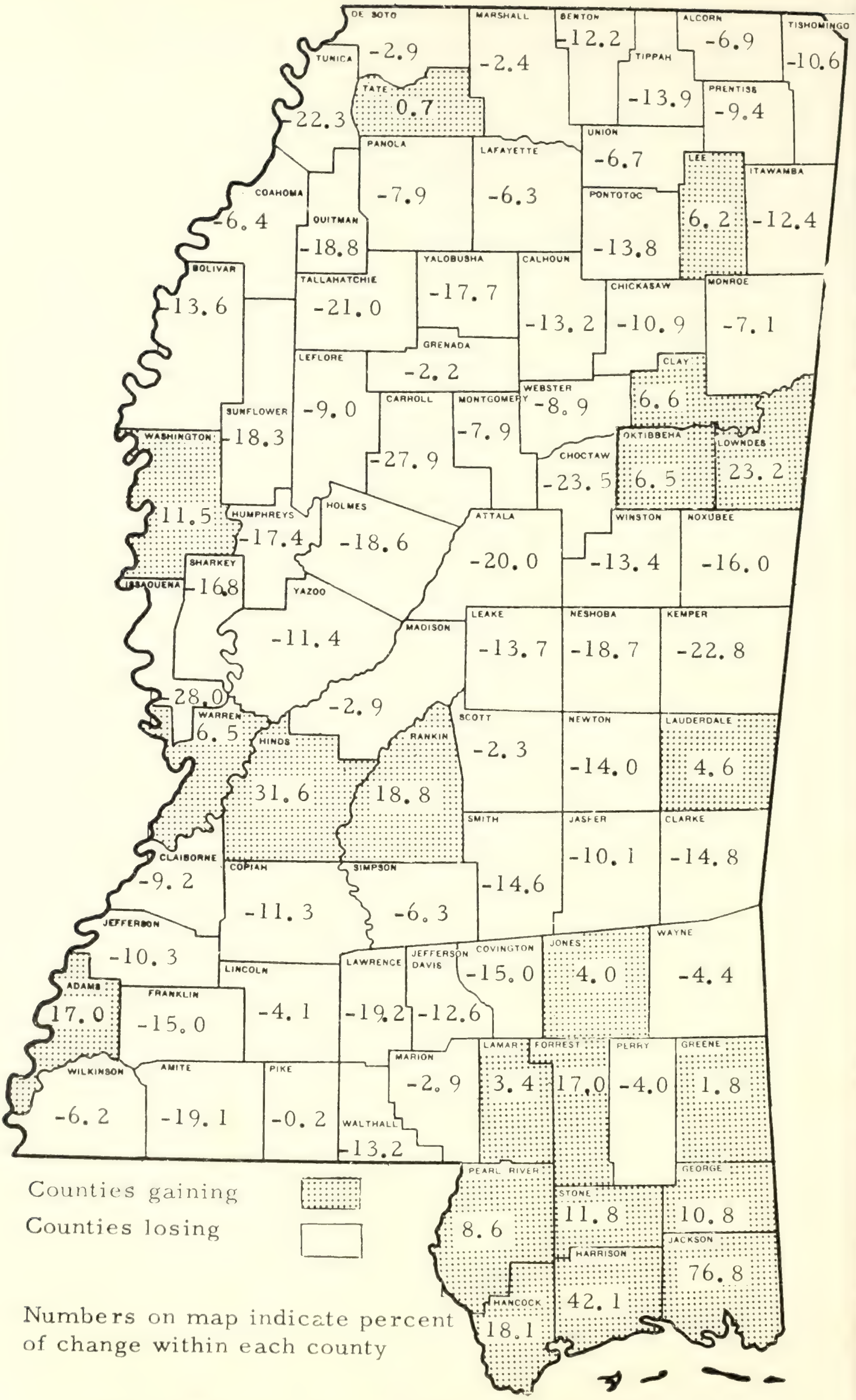

DE SOTO -2.9
MARSHALL -2.4
BENTON -12.2
TIPPAH -13.9
ALCORN -6.9
TISHOMINGO -10.6
TUNICA -22.3
TATE 0.7
PRENTISS -9.4
PANOLA -7.9
LAFAYETTE -6.3
UNION -6.7
LEE 6.2
ITAWAMBA -12.4
COAHOMA -6.4
QUITMAN -18.8
PONTOTOC -13.8
BOLIVAR -13.6
TALLAHATCHIE -21.0
YALOBUSHA -17.7
CALHOUN -13.2
CHICKASAW -10.9
MONROE -7.1
GRENADA -2.2
LEFLORE -9.0
CLAY 6.6
SUNFLOWER -18.3
CARROLL -27.9
MONTGOMERY -7.9
WEBSTER -8.9
WASHINGTON 11.5
OKTIBBEHA 6.5
LOWNDES 23.2
CHOCTAW -23.5
HUMPHREYS -17.4
HOLMES -18.6
ATTALA -20.0
WINSTON -13.4
NOXUBEE -16.0
SHARKEY -16.8
ISSAQUENA -28.0
YAZOO -11.4
MADISON -2.9
LEAKE -13.7
NESHOBA -18.7
KEMPER -22.8
WARREN 6.5
HINDS 31.6
RANKIN 18.8
SCOTT -2.3
NEWTON -14.0
LAUDERDALE 4.6
SMITH -14.6
JASPER -10.1
CLARKE -14.8
CLAIBORNE -9.2
COPIAH -11.3
SIMPSON -6.3
JEFFERSON -10.3
WAYNE -4.4
LINCOLN -4.1
LAWRENCE -19.2
JEFFERSON DAVIS -12.6
COVINGTON -15.0
JONES 4.0
ADAMS 17.0
FRANKLIN -15.0
MARION -2.9
LAMAR 3.4
FORREST 17.0
PERRY -4.0
GREENE 1.8
WILKINSON -6.2
AMITE -19.1
PIKE -0.2
WALTHALL -13.2
PEARL RIVER 8.6
STONE 11.8
GEORGE 10.8
JACKSON 76.8
HARRISON 42.1
HANCOCK 18.1
Counties gaining ▨
Counties losing ☐
Numbers on map indicate percent of change within each county

Figure 1. Population changes of Mississippi counties, 1950 to 1960.

BULLETIN 609 JANUARY 1961

Results Of 1960

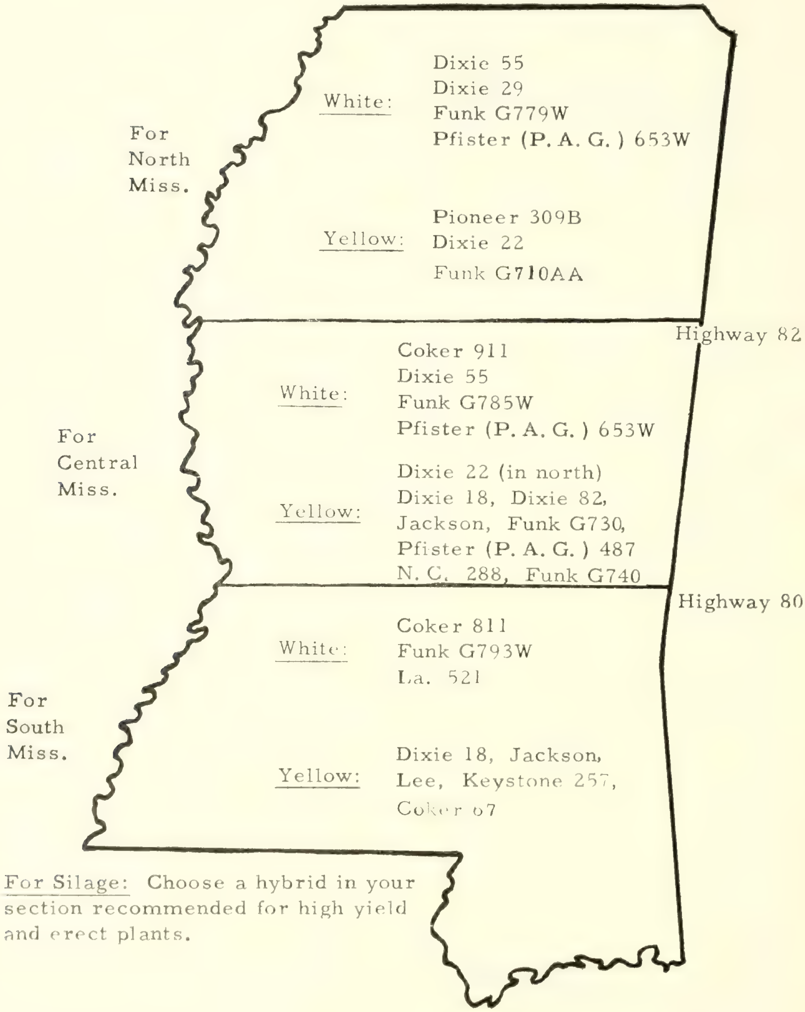
Hybrid Corn Tests In Mississippi

LL MEMORI
JUN 16 1961

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

Hybrids on this recommended list have the best average performance record for the past three years in the region in which they are recommended.

For other hybrids with satisfactory performance records see Table 1 through 5 in this bulletin.



For North Miss.

White:
Dixie 55
Dixie 29
Funk G779W
Pfister (P. A. G.) 653W

Yellow:
Pioneer 309B
Dixie 22
Funk G710AA

For Central Miss.

White:
Coker 911
Dixie 55
Funk G785W
Pfister (P. A. G.) 653W

Yellow:
Dixie 22 (in north)
Dixie 18, Dixie 82,
Jackson, Funk G730,
Pfister (P. A. G.) 487
N. C. 288, Funk G740

For South Miss.

White:
Coker 811
Funk G793W
La. 521

Yellow:
Dixie 18, Jackson,
Lee, Keystone 257,
Coker 67

For Silage: Choose a hybrid in your section recommended for high yield and erect plants.

1960 Hybrid Corn Tests

By C. M. CAMPBELL and C. O. GROGAN[1]

The 1960 growing season was generally unfavorable for corn in most sections of Mississippi due to the extended period of sub-normal rainfall during June, July, and early August. This is the period when the crop makes its greatest demands on the moisture reserves of the soil. Rapid vegetative growth, pollen formation, and early ear development all take place during this short period of six to eight weeks. Any soil moisture deficit within this time will reduce yields, but is especially detrimental if it occurs during the few days when pollination takes place.

Favorable weather in the spring permitted planting on schedule at most locations and a dry fall made possible an early and uninterrupted harvest of the tests. Tests were conducted at thirteen locations in the state. Seven in the northern section were at Holly Springs, Verona, State College, Pontotoc (two tests), Stoneville and Clarksdale. The central region included tests at Brooksville, Raymond, Newton, Yazoo City, and Stoneville. The two southern region tests were located at Poplarville and Tylertown. The extreme drought at Newton destroyed the test there and no information could be salvaged. At each location there were six replications within a balanced lattice statistical design. Plots consisted of 10 hills each, planted by hand in checks 38" apart at State College, 42" at Poplarville and Tylertown, and 40" at the remaining locations. Check planting is used in tests to simplify note taking and harvesting. Hybrid performance is about the same whether checked or planted in rows. The desired stand was two plants per hill at all locations except Verona, Raymond, and Tylertown where three plants per hill were left when thinned.

The number of days to 50% silk measures amount of time it takes for plants to reach the reproductive stage, and determines generally whether a hybrid is early, mid-season, or late in maturity.

Information on hybrid response to insect infestation was collected by W. A. Douglas, C. A. Henderson, and R. A. Blanchard, U.S.D.A. Entomologists. The depth of earworm penetration from the tip of the cob was measured on ten ears per plot. Also, any ear showing any earworm feeding was counted as infested. Rice weevil and pink corn worm infestations were recorded at the same time. Husk extension and tightness are factors related to resistance to insect damage, particularly earworm. Hybrids with long tight husks covering the ear usually have the least ear damage from insects. Husk extension is measured from the tip of the cob to the tip of the husk. Husk tightness is determined by measuring the diameter of the silk channel at the tip of the cob after the husk covering is longitudinally bisected and half the husk pulled back exposing the ear.

Average number of ears per plant is a measure of the prolific nature of the hybrid. A hybrid averaging considerably more than one ear per plant is said to be prolific. This trait gives a hybrid more flexibility in adjusting to the season. During a poor season a prolific hybrid may average only one ear per plant, but in a favorable season it may average close to two ears per plant. Through a period of years including many types of growing season, the prolific hybrid has a definite advantage over the single-ear hybrid.

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[1] Agronomists, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture. In cooperation with the Mississippi Agricultural Experiment Station and the Entomology Division, Agricultural Research Service, U. S. Department of Agriculture. The tests were conducted jointly with agronomists at the branch experiment stations and Mr. M. A. Luter, farmer, Tylertown.

Table 1. Average of data of the 1960 North Mississippi main hybrid tests grown at Holly Springs, Verona, State College, Pontotoc (ridge and flatwoods), Clarksdale, and Stoneville.

Hybrid	Acre yield bu.		Lodging		Ear ht.	Ears per plant	Moist. in grain	Stand	Days to 50% silk**	Earworm		P.C.W.[2]*	Husk	
	1960	3 yr. av*	Root	Stalk						Penetration[1]	Ears infested	ears infested	Extension[3]	Tightness[4]*
		1958-60	%	%	ft.	no.	%*	%		in.	%	%*	in.	in.
Miss. 6131 (Exp)	70.7	78.4	4	16	4.1	1.2	14.4	94	74	1.1	92	93	2.9	0.69
Dixie 77	67.6		3	17	3.9	1.1	14.9	95	72	1.2	94	85	2.1	0.83
Miss. 6133 (Exp)	66.8	76.1	5	17	4.1	1.3	15.4	93	74	1.1	91	85	3.2	0.64
McCurdy 999	66.3		3	17	3.7	1.0	14.4	95	71	1.3	84	90	2.8	0.76
Riemer 305	66.1		4	17	4.5	1.2	15.1	81	74	1.3	89	91	3.2	0.66
PAG 653W (Pfister)	65.9	69.6	4	12	3.8	1.2	15.0	95	72	1.0	82	90	2.5	0.81
Funk G 710AA	65.6	70.0	4	12	4.0	1.0	15.2	95	74	1.4	85	95	1.8	0.99
Dixie 22	65.4	70.1	4	16	4.3	1.1	15.4	96	75	1.1	88	99	2.9	0.77
Dixie 55	65.1	74.9	4	15	4.4	1.2	15.1	94	76	1.1	85	93	3.1	0.65
Dixie 29	64.6	70.2	2	14	3.7	1.1	14.5	93	72	1.4	94	86	1.9	0.81
Pioneer 309B	64.1	70.2	1	14	3.4	1.0	15.1	94	72	1.4	87	86	1.9	1.03
Funk G 711AA	64.0		6	11	3.9	1.0	15.3	94	74	1.6	85	98	1.4	1.14
Pioneer 309A	63.5	66.1	1	12	3.5	1.0	14.1	96	71	1.6	94	95	2.4	1.04
Tenn. 501	63.4	65.1	6	23	3.2	1.1	14.3	93	69	1.7	93	88	1.6	0.98
Coker 616	63.4		7	13	3.4	1.0	15.0	94	72	1.3	90	81	2.2	0.83
Delta 8812	62.4		5	14	3.9	1.1	15.6	94	74	1.1	77	91	3.2	0.66
Funk G 779W	62.4	69.2	4	17	4.0	1.1	15.4	90	73	1.8	93	95	0.8	1.53
Riemer 302	62.0		3	20	4.3	1.0	15.0	93	74	1.5	83	96	2.4	0.85
PAG 488 (Pfister)	61.6	59.7	4	16	3.7	1.0	15.6	94	72	1.4	86	95	2.0	1.03
Stull 111y	60.3		4	20	3.7	0.9	14.8	94	70	2.4	90	85	1.2	1.25
PAG 480 (Pfister)	59.2		2	13	3.7	0.9	15.6	93	74	1.7	95	93	1.3	1.19
Mid South	59.1	64.1	3	9	4.0	1.0	15.3	93	73	2.2	85	93	2.5	0.88
Keystone 256	57.7	66.0	3	11	4.4	1.0	15.0	96	75	1.1	83	90	3.1	0.70
DeKalb 633	56.4		3	9	3.0	0.9	13.7	93	67	2.8	78	88	1.7	1.07
DeKalb 869	55.2		2	9	3.1	0.9	13.9	93	67	2.8	83	91	2.3	0.96
Mean	63.2		4	15	3.8	1.1	14.9	93	72	1.5	87	91	2.3	0.91

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear. *Stoneville and Clarksdale excluded. **State College only.

Exp. indicates an experimental hybrid not yet commercially available.

The number of plants showing a degree of root and stalk lodging which would have interfered with mechanical harvesting was counted at harvest. The yields reported include all grain produced on a plot even though it may have been necessary to pick it off the ground. It is therefore important to consider the lodging potential of a hybrid as well as yield, especially if mechanical harvesting is planned.

Three groups of hybrids were tested, one for each of the three sections of the state from north to south. Hybrids selected for testing in a region are those which are being offered for sale there and already occupy an appreciable portion of the total acreage planted to hybrids. Several of the most promising experimental hybrids resulting from the breeding programs in progress at State College and the Delta Branch Experiment Station were also included.

When experimental hybrids have demonstrated a consistent superiority over existing hybrids for a period of at least three consecutive years, they may be released for general sale and given a Dixie designation as was the case with Dixie 55, Dixie 77, Dixie 18, etc.

Each hybrid bearing a Dixie designation is a product of the breeding program at one of the state experiment stations in the deep South. For example, Dixie 55 was developed at the Mississippi State University through the cooperative efforts of State and Federal breeders, agronomists, entomologists, and pathologists. Unlike most privately developed hybrids, the pedigrees of the Dixie hybrids are a matter of public information.

Any qualified seed producer may apply

Table 2. Average yield of the 1960 individual North Mississippi main hybrid corn tests.

	All Tests	Holly Springs	Verona	State College	Pontotoc (Ridge)	Pontotoc (Flatwoods)	Clarksdale	Stoneville
Miss. 6131 (Exp.)	70.7	56.3	49.3	84.0	46.6	46.2	50.4	161.8
Dixie 77	67.6	53.9	47.6	77.8	48.7	50.5	58.3	136.3
Miss. 6133 (Exp.)	66.8	50.0	43.1	83.9	44.5	42.0	46.2	158.2
McCurdy 999	66.3	50.3	56.8	80.5	42.6	44.7	56.6	132.4
Riemer 305	66.1	45.6	51.5	90.1	44.7	44.4	47.5	139.0
PAG 653W	65.9	49.8	52.9	81.5	46.6	38.0	55.4	136.8
Funk G 710AA	65.6	42.7	51.7	83.3	39.9	40.6	55.6	145.7
Dixie 22	65.4	50.1	45.5	85.4	39.7	36.7	57.5	142.6
Dixie 55	65.1	46.8	51.2	81.0	39.6	50.2	46.7	140.5
Dixie 29	64.6	44.1	47.7	83.5	37.6	41.5	57.7	141.1
Pioneer 309B	64.1	52.2	49.8	82.4	45.1	41.2	52.6	125.6
Funk G 711AA	64.0	45.9	50.2	86.4	43.4	37.2	50.6	134.4
Pioneer 309A	63.5	52.1	50.8	80.5	43.4	36.7	54.5	126.3
Tenn. 501	63.4	48.8	47.7	80.6	41.7	44.8	57.3	122.9
Coker 616	63.4	53.3	48.8	74.9	43.7	38.6	54.6	129.8
Delta 8812	62.4	47.1	50.5	77.0	39.0	39.7	46.5	144.7
Funk G 779W	62.4	41.3	49.8	85.3	40.6	40.7	52.9	126.5
Riemer 302	62.0	46.4	46.5	76.3	41.3	36.7	55.2	131.3
PAG 488 (Pfister)	61.6	47.5	47.4	78.3	43.0	34.4	51.5	129.0
Stull 111y	60.3	46.4	55.3	80.2	38.7	37.0	42.8	121.4
PAG 480 (Pfister)	59.2	41.6	41.8	74.8	36.6	33.6	56.9	128.9
Mid South	59.1	44.6	42.2	79.1	37.2	37.0	39.6	133.8
Keystone 256	57.7	39.6	41.8	71.2	39.0	33.1	37.5	141.8
DeKalb 633	56.4	48.5	48.9	70.3	43.2	33.7	39.6	110.3
DeKalb 869	55.2	49.4	49.9	71.7	39.3	26.9	38.9	110.1
Average	63.3	47.7	48.7	80.0	41.8	39.4	51.0	134.0
L.S.D. 5%		6.2	6.5	7.1	5.8	8.4	10.1	8.9

Both tests at Stoneville (Tables 2 and 4) were irrigated.

Table 3. Average of data of the 1960 Central Mississippi main hybrid tests grown at Stoneville, Brooksville, Raymond, and Yazoo City.

Hybrid	Acre yield bu		Lodging		Ear ht.	Ears per plant	Moist. in grain	Stand	Earworm		P.C.W.[2]	R.W.[5]	Husk	
	1960	3 yr. av. 1958-60	Root	Stalk					Penetration[1]	Ears infested**	ears infested	Ears infested	Extension[3]	Tightness[4]
				%*	ft.	no.	%***	%*	in.	%	%	%	in.	in.
Funk G720	82.6		13	10	3.8	1.0	13.8	93	1.4	94	100	65	2.3	0.88
Dixie 55	81.7	81.3	9	20	4.1	1.2	14.3	92	1.2	86	100	65	3.3	0.64
Funk G 785W	81.5	79.4	16	20	4.1	1.3	14.0	96	1.3	95	100	62	2.4	0.70
Dixie 82	80.9	79.4	11	24	4.3	1.2	14.4	90	1.2	88	100	50	2.9	0.72
Riemer 308	79.4		17	20	4.7	1.3	14.0	88	1.4	90	100	50	3.2	0.69
Dixie 22	78.9	73.6	11	30	4.0	1.1	14.4	93	1.5	91	98	67	2.5	0.82
N.C. 288	78.1	73.3	22	12	4.0	1.1	13.8	94	1.5	97	100	62	2.9	0.64
Funk G 740	77.6	74.4	7	29	4.2	1.1	14.1	94	1.2	82	100	37	2.6	0.70
McCurdy 1003C	77.4	67.8	19	24	4.2	1.1	13.7	90	1.0	85	100	65	3.3	0.69
Pfister (PAG) 653W	77.1	73.3	10	23	3.5	1.2	13.8	91	1.2	88	100	60	2.5	0.76
Pioneer 309B	76.9		14	25	3.3	1.1	14.3	94	1.4	88	100	57	2.0	0.86
DeKalb 1240	76.0		17	30	4.2	1.4	14.0	94	1.1	68	98	45	3.0	0.64
Funk G 730	75.5	73.7	19	26	3.6	1.1	13.7	90	1.4	90	100	50	2.8	0.66
Riemer 302	75.2		8	24	3.9	1.0	13.6	93	1.6	92	100	70	2.3	0.90
DeKalb 1201	74.3		22	25	4.0	1.0	13.6	95	1.2	86	100	62	2.6	0.73
Coker 67	74.3	70.0	22	18	3.7	1.4	14.1	92	0.8	78	100	37	2.8	0.62
Dixie 18	74.2	73.5	11	21	4.8	1.2	13.6	94	1.0	88	98	40	3.5	0.58
DeKalb 1225	73.9		19	17	4.6	1.1	13.9	93	1.1	84	100	55	3.0	0.60
Keystone 257	73.1		12	14	4.3	1.1	14.4	92	0.9	81	98	55	3.0	0.62
Coker 911	72.5	72.0	12	18	3.5	1.1	13.9	94	1.4	87	100	55	2.1	0.84
Pfister (PAG) 488	71.6	62.4	15	23	3.5	1.1	13.8	91	1.7	86	100	62	1.9	0.88
Jackson	71.6	71.9	12	19	4.8	1.2	14.2	93	1.0	86	100	52	3.3	0.64
Coker 71	71.0		19	9	3.8	1.2	13.8	94	0.8	76	100	37	2.9	0.62
Lee	70.4	65.3	11	22	4.3	1.2	14.0	97	0.9	86	98	47	3.6	0.62
Pfister (PAG) 487	69.8	72.9	8	28	3.9	1.1	13.8	94	1.3	94	100	57	2.5	0.70
Mean	75.8		14	21	4.0	1.2	14.0	93	1.2	87	100	54	2.8	0.71

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear. [5] Rice weevil.

*Except Yazoo City. **Except Stoneville. ***Except Stoneville and Yazoo City.

for permission to produce certified seed of a Dixie hybrid. This fact emphasizes the importance of buying seed of a Dixie hybrid from reputable seedsmen who use great care in its production, drying, and processing. Many commercial seedsmen exercise equal care. The excellent inherent capacity of a hybrid can be nullified by low quality seed resulting from poor production and processing procedures. If it is necessary to pay a premium for quality seed, it is a sound investment.

Table 4. Average yield of the 1960 individual Central Mississippi main hybrid tests.

Hybrid	All tests	Brooks-ville	Raymond	Stone-ville	Yazoo City
Funk G720	82.6	63.8	44.9	129.3	92.5
Dixie 55	81.7	60.6	46.6	131.8	87.8
Funk G785W	81.5	66.5	43.4	133.4	82.6
Dixie 82	80.9	63.3	42.1	126.6	91.7
Riemer 308	79.4	65.6	44.9	122.5	84.8
Dixie 22	78.9	63.2	45.9	118.9	87.5
N. C. 288	78.1	60.7	41.0	128.8	81.9
Funk G740	77.6	59.8	41.9	127.4	81.1
McCurdy 1003C	77.4	62.6	45.7	119.7	81.8
Pfister (PAG) 653W	77.1	52.6	47.7	123.3	84.8
Pioneer 309B	76.9	57.2	49.6	119.0	81.8
DeKalb 1240	76.0	61.0	35.2	135.5	72.3
Funk G730	75.5	59.2	41.4	123.3	78.2
Riemer 302	75.2	61.3	43.8	113.3	82.2
DeKalb 1201	74.3	54.4	43.0	118.4	81.4
Coker 67	74.3	53.6	38.8	119.2	85.5
Dixie 18	74.2	56.0	39.7	124.4	76.9
DeKalb 1225	73.9	57.6	36.7	124.4	76.9
Keystone 257	73.1	56.1	37.8	121.3	77.2
Coker 911	72.5	49.8	49.8	110.3	80.2
Pfister (PAG) 488	71.6	56.7	47.5	109.0	73.3
Jackson	71.6	61.4	34.1	122.3	68.4
Coker 71	71.0	51.3	45.0	111.7	76.1
Lee	70.4	58.4	33.1	117.6	72.5
Pfister (PAG) 487	69.8	53.5	41.6	113.6	70.5
Mean	75.8	58.6	42.4	121.8	80.4
L.S.D., 5% level		6.1	9.3	9.6	10.4

Table 5. Average of data of the 1960 South Mississippi main hybrid tests grown at Poplarville and Tylertown.

Hybrid	Acre yield bu. 1960	Acre yield bu. 3 yr. av.*	Lodging** Root	Lodging** Stalk	Ear ht.	Ears per plant	Moist. in grain	Stand	Earworm** Pene-tration[1]	Earworm** Ears in-fested	P.C.W.[2]** ears in-fested	R.W.[5]** ears in-fested	Husk** Exten-sion[3]	Husk** Tight-ness[4]
		1958-60	%	%	ft.	no.	%	%	in.	%	%	%	in.	in.
Miss. 6002 (Exp.)	42.2	49.3	0	18	4.2	1.0	13.6	93	0.6	62	97	35	3.8	0.54
Coker 67	41.6	43.4	1	9	3.6	1.0	13.6	92	0.5	42	97	32	3.5	0.53
Funk G740	41.5	40.9	0	32	3.8	1.0	13.6	90	0.7	52	97	40	2.9	0.58
Coker 71	41.4	....	5	13	3.5	1.0	14.1	92	0.4	42	100	27	3.0	0.55
Miss. 8440 (Exp.)	41.2	....	0	15	4.0	1.0	14.2	88	0.5	45	100	40	3.7	0.58
Dixie 55	40.6	....	0	15	3.8	0.9	13.4	90	0.6	47	100	72	3.1	0.64
Lee	40.2	42.9	0	17	3.9	1.0	13.8	90	0.6	47	97	42	3.6	0.53
DeKalb 1225	40.1	....	0	17	4.5	1.0	13.2	90	0.7	60	97	32	3.0	0.55
Miss. 6004 (Exp.)	40.0	....	3	20	4.2	0.8	13.8	96	0.6	52	97	50	3.7	0.59
Miss. 6111 (Exp.)	40.0	....	0	5	4.6	0.9	14.4	92	0.9	67	100	37	3.2	0.67
Miss. 6115 (Exp.)	40.0	....	2	6	4.6	0.8	13.6	90	1.0	72	100	52	2.2	0.71
Miss. 8288 (Exp.)	39.0	....	0	17	4.2	0.9	13.4	82	0.8	70	95	52	3.4	0.58
Keystone 257	38.5	47.0	0	26	4.2	0.8	13.4	88	0.5	45	100	45	3.1	0.55
McCurdy 100 3C	37.5	35.3	5	30	3.9	1.0	13.4	85	0.9	75	100	60	3.5	0.59
Jackson	37.0	42.2	0	10	4.4	1.0	13.6	85	0.5	47	97	55	3.3	0.60
'Fla. 200	36.9	....	1	16	4.0	0.9	13.8	92	0.8	65	97	42	3.6	0.52
Miss. 8484 (Exp.)	36.5		0	11	4.1	0.9	13.8	87	0.6	50	100	35	3.3	0.52
Miss. 8464 (Exp.)	36.2	42.6	0	14	3.8	0.8	14.4	82	0.5	45	100	42	3.0	0.59
Coker 811	36.2	42.3	0	7	3.6	0.9	13.9	95	0.6	42	97	45	3.1	0.55
Funk G793W	35.5	42.7	0	17	4.2	0.8	14.0	90	0.5	47	95	67	3.1	0.55
Riemer 308	35.0	....	0	17	3.9	1.0	13.4	76	0.7	55	100	42	3.0	0.60
Dixie 18	34.2	44.1	0	26	4.4	1.0	13.3	90	0.4	37	97	35	3.6	0.52
Miss. 8305 (Exp.)	33.8		2	8	4.3	0.8	14.2	84	1.0	70	100	55	3.2	0.56
DeKalb 1240	33.2	....	1	18	4.2	1.0	13.1	87	0.7	60	97	40	2.8	0.53
Riemer 408	30.2	....	0	8	4.2	0.9	13.7	77	0.9	67	100	32	3.2	0.57
Mean	37.9	....	1	16	4.1	0.9	13.7	88	0.7	54	98	44	3.2	0.57

[1] Inches from tip of ear. [2] Pink corn worm. [3] Inches beyond tip of ear. [4] Diameter of silk channel at tip of ear. [5] Rice weevil.
*Poplarville only. **Tylertown only.

BULLETIN 610 JANUARY 1961

Mississippi Crop and Fertilizer Recommendations

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MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director
STATE COLLEGE MISSISSIPPI

CROP AND FERTILIZER RECOMMENDATIONS FOR MISSISSIPPI

At timely intervals the Mississippi Agricultural Experiment Station issues crop and fertilizer recommendations based on the latest research findings at State College and ten Branch Experiment Stations in the State. Included is information on fertilization, varieties, and rates of seeding for crops generally grown in Mississippi as well as information pertaining to lawns, turf grasses and home gardens.

Because of varying soil and weather conditions and other local factors, no single crop variety or fertilizer will fit the entire state perfectly; nonetheless, these general recommendations are useful guides to crop production. Of course, these recommendations assume that other good farming practices will be followed.

Details and qualifications are omitted in most cases; if you need information on any crop you may obtain it from the Extension Service, the Experiment Station, your County Agent, or other trained agricultural workers in your locality.

Soil Testing Service

The farmer realizes maximum profits from his fertilizer dollar only when the right kind and amount of fertilizers are used on each field. Through the Mississippi State Soil Testing Service every farmer can get detailed information about how much and what kind of fertilizer and lime to apply to each field. Furthermore, the Soil Testing Service makes fertilizer and lime recommendations for exceptionally high production goals and for contest fields which are not provided for in the general recommendations.

Soil testing is a free service. Soil sample boxes, mailing cartons, and instructions for collecting samples are available in each county agent's office and the offices of other agricultural agencies.

Plant Nutrients

Plant nutrients can be divided into two groups: (1) Those elements used by crops in relatively large amounts; and (2) those needed in very small amounts.

The first group includes nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur. The first three of these are usually called the "fertilizer nutrients" and are often applied to crops either as straight materials or mixed fertilizers. Straight materials are those which contain only one fertilizer nutrient. Some examples of straight materials are listed below:

Material	**Total Nitrogen (N)**
Ammonium nitrate	33 1/3%
Anhydrous ammonia	82%
Nitrate of soda	16%
	Available Phosphate (P_2O_5)
Superphosphate	18 to 20%
	Available Potash (K_2O)
Muriate of potash	60%

Mixed fertilizers contain two or more of the fertilizer nutrients, and each fertilizer bag is stamped with a set of numbers to show how much plant food it contains. The first number always shows the percentage nitrogen (N), the second represents the percentage available phosphate (P_2O_5), and the third shows percentage water-soluble potash (K_2O). One hundred pounds of a 5-10-10 fertilizer thus contains 5 lbs. of total N, 10 lbs. of available P_2O_5, and 10 lbs. of available K_2O. The fertilizer **ratio** refers to the relative amounts of these nutrients. The fertilizer **grade** gives the specific amounts of each fertilizer nutrient it contains. For example, 8-8-8 and 10-10-10 are two different grades in a 1-1-1 ratio. Similarly, 6-8-8 and 9-12-12 are two grades in a 3-4-4 ratio.

For the most part fertilizer recommendations are given in this circular as pounds of N, P_2O_5, and K_2O needed per acre. Usually the farmer will have a choice of more than one fertilizer grade. For example, 48 lbs. N. 48 lbs. P_2O_5, and 48 lbs. K_2O may be supplied with 600 lbs. of 8-8-8 or 400 lbs. of 12-12-12. Cost per unit of fertilizer and ease of handling should determine form and grade used. Since small deviations from the general recommendation will not affect profits significantly, it is not necessary to apply exactly the amounts of N, P_2O_5, or K_2O called for. If, in the case described above, only a 10-10-10 were available, the farmer should use 500 lbs. per acre thus giving a total of 50 lbs. of each nutrient.

Liquid mixed fertilizers were introduced into Mississippi recently and have been thoroughly tested by the Agricultural Experiment Station. Results of these tests show that pound for pound of fertilizer nutrient, liquid fertilizers are just as effective as solid fertilizers. According to state laws, liquid fertilizers must meet the same specifications as solid fertilizers except that the grade 4-11-11 was approved for liquid fertilizers only.

Calcium is usually applied to crops as agricultural limestone although the primary purpose of liming soils is to correct soil acidity by raising the pH. A more complete discussion of lime and liming is found elsewhere in this circular. Magnesium may also be supplied in "dolomitic" limestone or, on soils needing magnesium but not requiring lime, as a soluble source of magnesium such as Sul-Po-Mag. Magnesium deficiencies have been found so far only in parts of the Black Land Area of Mississippi.

Sulfur is an incidental component of superphosphate and is also contained in ammonium sulfate; therefore, when these materials (or mixed fertilizers formulated from these materials) are applied, sulfur is also added to the soil. However, changes in fertilizer technology have made possible the manufacture of fertilizer materials and mixtures containing very little sulfur. Research has shown that deficiencies are likely to occur on soils of the Hill Section when sulfur is omitted from the fertilizer program. Instances of deficiency have also occurred in the Delta. Sulfur deficiencies have been associated with land leveling in some cases, but they are not restricted to the areas which have been leveled. Sulfur deficiencies can be corrected by applying gypsum or by using superphosphate, ammonium sulfate, or mixed fertilizers that contain sulfur.

The **second group** of nutrients is called "trace" or "minor elements" or "micronutrients" because they are needed by crops in very small amounts. Included are zinc, boron, iron, manganese, copper, and molybdenum. Except for boron on alfalfa and for seed production of such legumes as white and crimson clover, zinc under tung and pecan trees, minor element deficiencies are not widespread in Mississippi. Of course, small isolated problem areas may exist throughout the state. Failure of cotton to produce normally in localized areas following the application of lime may be associated with boron deficiency, which probably results from over-liming of localized areas due to uneven distribution of lime. For advice about suspected minor element problems, the farmer should contact his County Agent.

Soil pH and Liming

Excess soil acidity or a deficiency of lime reduces crop yields. A recent survey made by the Mississippi Soil Testing Laboratory showed that 68 percent of the soils tested needed lime.

The degree of acidity or alkalinity of a soil is expressed by the pH scale; values below 7.0 indicate an acid soil, above

7.0 an alkaline soil. Soil reaction, or pH, affects the availability of some of the more important plant nutrients in the soil. Phosphate is much less available in very acid soils than in slightly acid to mildly alkaline soils. In very strongly acid soils, (pH below 5.0) certain elements such as manganese and aluminum are changed to available forms in such quantities as to become toxic to plants. Essential plant nutrients such as iron, manganese, boron, and zinc rapidly become less available as the pH of the soil increases above 7.0. This is one reason why one must not overlime. Experience has shown that overliming injury in Mississippi is very likely to be associated with deficiencies of boron and zinc. In the case of cotton and legumes, it is very likely to be due to boron deficiency and with corn, and perhaps other grasses, to zinc deficiency.

It has been found that soils with a pH of 6.0 or higher are well supplied with lime and at the same time maintain the other nutrients in forms sufficiently available to crops. If the pH is less than 5.0, the soil is very strongly acid and is extremely deficient in lime. Most non-legumes grow best if the soil pH is not allowed to drop much below 5.5 while most legumes do best if the pH is maintained above 5.5. Alfalfa grows best at soil pH values above 6.0.

The amount of lime required to raise the pH of the soil to a desired value depends on both the initial pH and the lime holding capacity of the soil. On soils of Mississippi having a pH of 5.5 or slightly below, the application of 3000 pounds of lime per acre to sandy loam and loam soils, 5000 pounds to silt loam soils, and 7000 to 9000 pounds to clay loam and clay soils has been found to give satisfactory results in correcting lime deficiency for legumes. Since about two-thirds of the soils of the state have natural pH values of 5.5 or above, application of the above rates of lime would bring or maintain the pH of a large majority of the soils within the range that is very favorable for legumes. But where such a program is followed, too much lime will be added to some soils and not enough to others. For example, the black upland soils and the bottom soils of the Northeast Blackland area seldom need lime even for legumes. A better practice would be to initiate a soil testing program on each farm and sample each field at least once in five years. Whenever the soil pH drops to an unfavorable level, the Soil Testing Laboratory will make specific recommendations as to the amounts of lime required.

It is a better practice to mix lime thoroughly with the top five to six inches of the soil, but, depending on the texture 1000 to 2000 pounds may be applied as a surface application to permanent pastures, or other permanent sods.

Lime is naturally lost from the soil by crop removal and by leaching. The use of acid forming sources of nitrogen and the turning under of legumes as soil builders accelerate these losses. For example, 100 pounds of nitrogen from such sources as ammonium nitrate, anhydrous ammonia and urea will cause the loss of calcium and other bases equal to about 200 pounds of lime. When applied annually at this rate, the loss would amount to one ton of lime every ten years due to fertilizer alone. This, together with natural losses indicates that soils require lime at periodic intervals.

Generally, on sandy loam, loam, and silt loam soils a maintenance application of one ton of lime per acre once every 5 to 7 years will be required for legumes and for non-legumes fertilized with nitrogen as recommended. On clay loam and clay soils less frequent but larger applications may be made. Although lime may be needed badly on some soils for non-legumes, the deficiency is not sufficiently general to warrant a recommendation for its general use to raise the soil pH values to a more favorable range but maintenance applications should be made as indicated before to prevent more soils becoming deficient. Areas going into permanent grass sod should receive the initial maintenance application of lime prior to establishment. Subsequent maintenance applications may be applied to the surface.

The principal liming materials available in Mississippi are ground calcic and dolomitic limestones, crushed chalk or marl from Mississippi deposits and basic slag. Calcic limestones contain calcium carbonate while dolomitic limestones contain both calcium and magnesium carbonates. Liming materials from Mississippi deposits contain calcium carbonate only. Basic slag, a material containing a minimum of 8 percent P_2O_5 and the equivalent of about 75 percent lime is priced largely on the basis of its phosphate content, and should be used only where both the lime and phosphate are needed. The cost for its use as a liming material only is prohibitive.

Research has shown that all these materials are very effective in neutralizing soil acidity providing the calcic and dolomitic limestones have been finely ground. Particles not passing a 40-mesh screen (40 holes per linear inch) are not very effective in neutralizing soil acidity. For this reason 90 to 100% of calcic and dolomitic limestones should pass a 10-mesh screen and 50% a 100-mesh screen. Particle size is not as important in the case of the Mississippi liming materials which contain clay as an impurity which causes the particles to break down so that they react with the soil. They must be crushed finely enough however, so that they can be spread uniformly.

Generally, the Delta and Deep Loess soil areas are abundantly supplied with magnesium and a calcic lime will be satisfactory. In the other soil areas of the state, magnesium levels tend to be lower and a liming material containing considerable magnesium, such as dolomitic lime, should be used, particularly in the Northeast Blacklands.

Fertilizer Efficiency

In crop production the primary objective of using fertilizers is to increase the net profit per acre. The rate of fertilizer required for maximum profit per acre depends on many factors. Some of the more important ones are: (1) crop, (2) soil and fertilizer characteristics, (3) time and method of application of fertilizer, (4) degree of insect, disease, and weed control, (5) weather, (6) tillage practices, and (7) increase in yield, together with the ratio of costs to returns from fertilizer. Under a given set of circumstances, the efficiency of utilization of fertilizer by a crop may be greatly affected by time and/or method of application.

Time of Application

In general fertilizer nutrients are reduced in effectiveness following their application to the soil because of loss by leaching and conversion to less available or to unavailable forms.

Fertilizers may contain nitrogen in the form of nitrate or ammonium, or both, or in other forms (urea and cyanamide) that are changed rather rapidly to ammonium when applied to the soil. Nitrate salts found in fertilizers and in soils are highly soluble in water and since they are not retained by combining with the soil, they are easily leached from the root zone, particularly on sandy loam, loam, and silt loam soils or other soils where water percolates easily through the soil profile. Under water-logged conditions nitrates in soils may be changed by soil organisms (denitrification) to gaseous nitrogen which escapes into the atmosphere. Ammonium nitrogen is not denitrified; neither is it easily lost by leaching because it combines chemically with the clay and organic matter. However, it is soon converted by soil bacteria to nitrate salts which may be lost as just indicated.

Thus, it is evident that nitrogeneous fertilizers are not retained in soils of Mississippi for long periods, and accordingly, maximum efficiency for crop production is generally obtained by applying the nitrogen at or near the beginning or during the growing season.

Phosphate fertilizers are not lost from soils by leaching, but their availability to plants is reduced, particularly in acid soils, because they react rather rapidly with iron and aluminum to form phosphates that are much less available to plants. The reactions are referred to as "phosphate fixation." Because of this fixation, annual, seasonal applications of phosphate, are better than less frequent or off-season applications. This is true for both annual and perennial crops. In general, best results are obtained by applying phosphate fertilizers at or just prior to seeding, or near the beginning of the growing period in the case of maintenance applications to perennial crops.

The effectiveness of potassic fertilizers is not reduced appreciably by fixation as is phosphate, nor is the potassium as easily leached from soils as nitrate. However, on sandy loam, loam, and silt loam soils the extent of loss by leaching is such that annual, seasonal applications are better than less frequent applications. Also, with harvested forage crops excessive uptake (luxury consumption) and removal of the potash in the harvested portion makes annual, and sometimes split, seasonal applications necessary even where the potash would not be lost by leaching. This is especially true where multiple harvests of forage crops like alfalfa, which are very heavy users of potash, are made.

Fall or winter plowing to prepare a seed bed is highly desirable, if not essential, for successful row-crop production on heavy clay soils. Where equipment is not available for proper placement of fertilizer in a prepared seed bed in the spring, the phosphate, and potash, and magnesium where recommended should be applied at the time the seed bed is prepared. The method of application should be such that the location with respect to the seed row will be in conformity with the recommendations for the crop in question. Except for the black clay upland soils and the clay bottom soils of the Northeast Blackland Area, or other clay soils known to be either slightly acid or alkaline in reaction, the recommended rate of phosphate should be increased by about 30 percent when applied in the fall or winter.

From the foregoing observations it is evident that the soil, fertilizer and crop characteristics must be taken into account in order to time the application of fertilizer so that maximum availability to and need by the crop are made to coincide in so far as it is practical to do so. This is reflected in the recommendations given later.

Method of Application

In selecting a method for applying fertilizer, there are two factors of availability that must be considered: namely, positional and chemical.

Chemical availability refers to the capacity of the fertilizer to supply nutrients to plants. The chemical availability of phosphatic fertilizers is greatly affected by the method of application, particularly on acid soils. Banding water-soluble and other highly reactive phosphates as opposed to broadcasting and mixing them with the soil greatly increases their chemical availability because of reduced contact with the soil which in turn slows up the process of phosphate fixation. When coupled with proper placement with respect to the seed row of drill-seeded and row crops, the effectiveness of the phosphate sometimes is doubled. The chemical availability of potassic and nitrogeneous fertilizers is not so greatly affected by degree of contact with the soil, thus banding as opposed to broadcasting is of little advantage in this respect.

Positional availability refers to the location of the fertilizer with respect to the plant roots. For example, fertilizer placed in the soil a foot or so from the row is positionally unavailable to plants in the seedling stage.

Phosphatic and potassic fertilizers applied to the surface do not penetrate the soil to a very great depth. If applied in this way to row crops, they may remain positionally unavailable throughout the growing season because cultivation disturbs the soil, and plant roots do not persist in the surface inch or so where the fertilizers are held, particularly the phosphate. Also, nitrogenous fertilizers applied to the surface of the soil, particularly when dry, remain unavailable for the most part until dissolved and moved down into the root zone by percolating water. On most soils before ammonium sources of nitrogen are moved down into the root zone to any appreciable extent the ammonium must first be changed by soil bacteria to nitrate (nitrified), a process which usually requires 2 to 4 weeks for completion in moist soil during the spring and summer. If the nitrogen is applied far enough in advance for the necessary transformation and movement into the root zone to occur by the time it is needed by the crop, positional unavailability is avoided. Surface application of fertilizer is more effective with sod crops than with row crops except during periods of drought because plant roots develop and persist near the surface; in fact, this method is so effective that it is recommended for applying maintenance fertilizers to perennial, close-growing crops.

To be readily available to the seedling, the fertilizer must be placed relatively close to the seed, usually to the side of and below so that the fertilizer is contacted by the secondary roots soon after they have begun to develop. The fertilizer should be deep enough to be in moist soil most of the time during the growing season. On the other hand, to avoid salt injury to the germinating seeds and to the seedlings, care must be taken not to place the fertilizer too close to the seed, or in such a position that salts in excessive amounts may move in around the seed or seedling. Since the fertilizer salts in solution move upward or downward with soil water and to some extent laterally by diffusion, the fertilizer should be placed to the side of the seed-row, the distance depending on the kind and rate of application.

Nitrogen and potassium salts are largely responsible for salt injury due to improper placement of fertilizer. Unless they are drilled together in the same band, phosphatic fertilizers and the seed are not likely to come in contact with each other because the phosphate will not move far enough from the fertilizer band to contact the seed before reacting with the soil to become relatively insoluble in water and, thus, immobile.

With row crops and most drill-seeded crops both chemical and positional availability during the growing season are maximized and injurious concentrations of salts around the seeds or seedlings are avoided by placing the fertilizer in narrow bands at least two inches to the side of and two inches below the seed. The minimum separation may be employed with recommended rates of phosphate and potash and up to 40 pounds of nitrogen per acre. With higher rates of nitrogen and potash both the vertical and horizontal distances between the seed and fertilizer should be increased.

Although contact placement of seed and fertilizer should be avoided with most crops and is not the preferred practice in this case, recommended amounts of phosphate and a combined total of 50 pounds of potash plus nitrogen may be drilled with small grain or grass seeds without appreciable injury in most cases when the drills are spaced no more than 10 inches apart. Higher rates of fertilizer, particularly of potash and nitrogen, should be placed two inches or so below and to the side of the seed.

Supplementary nitrogen applied to small grains or other winter-growing crops in solid form or as non-pressure solutions may be broadcast or sprayed on the surface of the soil with satisfactory results. However, this may not be the case with urea or urea-ammonium nitrate solutions when applied in the late spring, summer, or early fall. When in contact with the soil or decomposing plant residues the nitrogen in urea is changed rapidly to ammonium by the action of the enzyme urease. This reaction proceeds much more rapidly in warm than in cold weather and in warm seasons is likely to occur to such an extent before the urea comes in contact with enough soil to react with and retain the ammonium that a significant amount of the nitrogen is lost as gaseous ammonia. This is more likely to occur on sandy or sandy loam than on other soils because they have a very low capacity to retain ammonium.

Recommendations for Major Field Crops

Corn

Hybrids are listed alphabetically in area of adaption.

North-Mississippi: (north of U. S. Highway 82). White: Dixie 29, Dixie 55, Funk G 779W, Pfister (P.A.G.) 653W. Yellow: Dixie 22, Pioneer 309 B, Funk G 710AA.

Central Mississippi: (north of U. S. Highway 80 and south of U.S. 82). White: Coker 911, Dixie 55, Funk G 785W, Pfister (P.A.G.) 653W. Yellow: Dixie 18, Dixie 22, Dixie 82, Pfister (P.A.G.) 487, Funk G 730, Jackson, N.C. 288, Funk 6740.

South Mississippi: (south of U. S. Highway 80). White: Coker 811, Funk G 793W, La. 521. Yellow: Dixie 18, Jackson, Lee, Keystone 257, Coker 67.

Silage Corn: Any full season hybrid recommended for your area having high grain yield and lodging resistance.

Land Preparation: Prepare a good seedbed on reasonably deep well-drained soil. Avoid steep, droughty, and eroded hillsides. Plant in South Mississippi from March 20 to April 10, in Central Mississippi from April 7 to April 20, and in North Mississippi from April 15 to May 7. Space plants 15 inches apart in rows 42 inches wide, or 16 inches apart in 40-inch rows. This will require 9 to 14 pounds of seed per acre, which is approximately one peck.

Fertilization, Hill and Delta Foothill Section: For the soils of this section a complete fertilizer is generally needed, and this should be supplemented by a side dressing application of additional nitrogen. When corn is grown successively for silage on a field for more than 3 years the fertilizer rates given below should be increased as follows: Nitrogen, 100 to 130; phosphate, 50, potash 100 pounds per acre.

Time: Apply the complete fertilizer at planting time. Supplemental nitrogen should be side-dressed by the time the corn is knee high. Timing of the side dressing is especially important as delay much beyond the knee-high stage may result in reduced yields.

Rate: The planting - time fertilizer should supply approximately 36 pounds each of N, P_2O_5, and K_2O. Optimum rates of P_2O_5 and K_2O. will vary with soil type and past history of fertilization; more specific recommendations may be obtained by having soils analyzed by the Soil Testing Laboratory. The side dressing application should supply 60 to 90 pounds of nitrogen per acre.

Method: Apply the planting-time fertilizer at least 2 inches to the side and 2 inches below the level of the seed. This placement may be obtained by attachments on the corn planter. If such attachments are not available the equipment at hand should be used to give this approximate relation between seed and fertilizer.

Fertilization, Delta Section: Time: Nitrogen may be applied at or prior to planting or in split applications, one-half at or before planting and the rest as a side-dressing before the corn is knee high.

Rate: 120 pounds of nitrogen per acre.

Method: Place preplant and planting time applications of nitrogen 4 to 6 inches from the drill row, non-pressure solutions and solid sources at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 or more inches below the level of the seed. Place side-dress applications of nitrogen 1 foot or more from the row, non-pressure solutions and solid sources at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 inches.

Cotton in the Hill Sections

Varieties: Auburn 56, Plains, Coker 100 A, Empire, Dixie King, Rex, Delfos 9169, Stoneville 7, Stoneville 3202, Deltapine Smooth Leaf, and Deltapine 15.

For soils infected with Fusarium Wilt —Auburn 56, Plains, Coker 100 A, Empire, Dixie King, and Rex.

Seeding Dates and Rates: Plant between April 10 and May 10 as weather permits. Hill dropped—16 to 22 pounds of delinted seed per acre. Drilled—20 to 30 pounds of delinted seed per acre. For undelinted seed increase rates by 10 to 15 pounds per acre. Seed should be of good viability.

Fertilization: A complete fertilizer containing sulfur generally is needed for cotton in the Hill Sections. In addition, the fertilizer for cotton on black and brown or brownish black soils of the northeast Blackland Area should contain enough magnesium in water-soluble form to supply at least one-half and preferably as much magnesia as potash. On soils known to have a pH of 6.0 or below dolomitic lime may be used as a source of magnesium if it is broadcast and mixed with the soil at the rate of one to two tons per acre. An application of two tons per acre will supply enough magnesium for ten or more years.

Under natural soil conditions cotton grows well within the pH range of 5.5 to 7.5 but acid soils should not be limed to raise the pH above 7.0. For liming recommendations see sections on Soil pH and Liming.

Time: Apply the phosphate and potash along with all or part of the nitrogen in the spring at or prior to planting with any supplemental nitrogen being applied as a side dressing by mid-June—one to two weeks earlier if anhydrous ammonia is used. Nitrogen sources having as much as one-half of the nitrogen in the nitrate form usually are more efficient on sandy loam, loam and silt loam soils if one-half to two-thirds of the nitrogen is applied as a side dressing but with other sources there is no particular advantage in splitting the application except on deep, excessively drained sandy or sandy loam soils.

Fall or winter plowing to prepare a

seed bed is highly desirable if not essential for successful cotton production on heavy clay soils. See section on Fertilizer Efficiency with regard to time of application of fertilizer to clay soils.

Rate: Apply 72 pounds of nitrogen (N), 48 pounds of phosphate (P_2O_5) and 48 pounds of potash (K_2O) per acre except as follows: Increase the rate of nitrogen to about 110 pounds per acre on the blackish and brownish, upland soils of the Northeast Blackland Area and to about 90 pounds per acre on the well-drained and bench-land soils of the Upper Coastal Plain and Northeast Blackland Areas.

On soils of light texture an application of as much as 144 pounds of nitrogen per acre frequently gives a slightly lower yield than the recommended rate and sometimes there is a marked reduction. Too much nitrogen reduces yields because it causes excessive vegetative growth, delays fruiting and increases the risk of shedding due to drought, and makes it more difficult to control insects. The likelihood of boll rot also is increased.

Method: Place complete fertilizers that supply up to one-half of the recommended nitrogen in narrow bands 2 to 3 inches to the side of and 2 to 3 inches below the cotton seed. With higher rates of fertilizer, particularly nitrogen and potash, increase both the vertical and horizontal separation of seed and fertilizer. Avoid contact placement of seed and fertilizer as well as shallow placement even of low rates of nitrogen or potassium containing fertilizers directly beneath the seed. Preplant and planting-time applications of anhydrous ammonia should be placed so as to be 4 to 6 inches to the side of and 4 to 6 inches below the seed. Where weeds and grass are not a problem, broadcasting solid sources or spraying non-pressure nitrogen solutions on the surface is about as effective as other methods of application at planting time.

Place side-dressing nitrogen in the edge of the root zone, usually a foot or so from the row, non-pressure solutions and solid sources 3 to 4 inches deep and anhydrous ammonia 6 inches deep.

Cotton in the Delta

Varieties: Auburn 56, Coker 100, Coker 124, Delfos 9169, Deltapine 15, Deltapine Smoothleaf, Dixie King, Empire, Fox A, Rex, Stoneville 7, and Stoneville 3202.

For wilt lands (Fusarium wilt): Auburn 56, Coker 100, Wilt, Dixie King, and Plains.

Seeding Dates and Rates: Plant as soon after April 1, as weather permits, but not in cold soil. Hill dropped—16 to 22 pounds of well delinted seed per acre. Drilled—30 to 40 pounds of well delinted seed per acre. Drilled for cross plowing —60 pounds of delinted seed per acre. Seed should be of good viability.

Fertilization: Delta soils generally need nitrogen fertilizer only for most profitable production, but in the foothills area, the use of phosphate and potash frequently may be profitable. Lime should be used to maintain the soil pH between 5.5 and 7.0.

Time: Apply nitrogen in the spring at or prior to planting except that on sandy loam soils having very good to excessive internal drainage one-half of the nitrogen should be side-dressed by mid-June.

Rate: Sandy loam, loam, and silt loam soils, 90 to 100 pounds of nitrogen per acre. Clay, silty clay, and clay soils, 100 to 120 pounds of nitrogen per acre.

Method: Place preplant and planting-time applications of nitrogen 4 to 6 inches from the drill row, non-pressure solutions and solid sources of nitrogen at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 to 8 inches below the level of the seed. Place side-dressing applications of nitrogen 1 foot or more from the row, non-pressure solutions and solid sources at a depth of 4 or more inches and anhydrous ammonia at a depth of 6 inches.

Rice in the Delta

Varieties: Bluebonnet 50, Century Patna 231, Nato, Zenith, and Gulfrose.

Seeding Dates and Rates: Rice can be seeded from mid-April to mid-June. The seeding rate should be 90 to 110 pounds per acre if drilled, and 120 to 125 pounds per acre if broadcast.

Fertilization: Phosphate and potash fertilizers generally are not required for the heavy clay soils devoted to rice production in the Mississippi Delta. Nitrogen is recommended except where rice is to be planted on newly cleared land. Nitrogen should be applied at the rate of 60 to 100 pounds per acre depending on previous cropping history. Excessive nitrogen causes lodging and should be avoided. On land relatively free of grasses, the nitrogen may be applied at planting or before the first watering. On fields known to have a grass problem, application of nitrogen should be delayed for 7 to 9 weeks after seeding, at which time the field should be drained and allowed to dry prior to applying the nitrogen.

Ammonium and urea sources of nitrogen have been more effective than nitrate sources for rice production.

Soybeans

Varieties: Hill, maturing in last half of September; Hood, maturing in early October; Lee, maturing in mid-October; and Jackson, maturing in late October. Lee should be grown as the major bean variety in all areas except deep South Mississippi, where Jackson should be given preference. Hill and Hood are well suited for production in the Delta area to supplement Lee and permit earlier harvest on land reasonably free from weeds.

Soils: Soybeans are adapted to all Delta soils and to the more productive soils of the Hill Sections, such as good bottom and bench-land soils. They will not produce satisfactory yields on eroded, droughty upland soils.

Seeding Dates and Rates: May 1 to June 1 except extreme South Mississippi June 1 to June 20. Plant 10 to 12 viable seed per foot of row. Where planted in 36 to 40 inch rows, this will require 40 to 50 pounds of good quality seed per acre.

Fertilization: Soybeans require no fertilizer on most Delta soils. Outside the Delta, fertilizer is usually necessary for satisfactory production and lime is needed on soils having a pH below 6.0. A soil test will suggest the fertilizer and lime needs. Good response can usually be expected from appplications of 30 pounds of phosphate (P_2O_5) and 60 pounds of potash (K_2O) per acre. Fertilizer should be applied as a band 2 to 3 inches to the side and 2 to 3 inches below the seed. Avoid contact placement of seed and fertilizer as well as placement directly beneath the seed.

Inoculation: If not on land where a crop of well nodulated soybeans has grown within the last five years, the seed should be inoculated.

Sorgo for Sirup and Silage

Varieties: Wiley for sirup — matures in late September. Tracy and Sart are best for silage. Tracy matures in late August to early September and Sart in late September, or in October. Sart out-yields Tracy. Honey (Texas seeded ribbon cane) yields well under favorable conditions but is more susceptible to disease and lodges badly; when diseased, the sugar content is too low for good silage. Harvest sorghum in the dough stage for silage and in the late dough stage for sirup.

Seeding Dates and Rates: April 20 to May 20. If seeded in hills 24 inches apart, plant 1 1/2 to 2 pounds of seed per acre and if drilled, 3 to 5 pounds per acre. A good stand is 3 to 4 plants per 2 feet of row whether arranged singly or in groups. Thicker spacing results in smaller stalks that are more likely to lodge as well as being more trouble to strip for sirup.

Fertilization: Apply 40 pounds of nitrogen (N), phosphate (P_2O_5) and potash (K_2O) per acre at planting time.

Place the fertilizer in a band 2 to 3 inches to the side and 2 to 3 inches below the level of the seed. Except on fertile bottom soils, side-dress with about 30 pounds of nitrogen per acre by the time the plants are knee high. See Section on Corn for suggestions as to placement of side-dressing nitrogen. Higher rates of nitrogen increase the likelihood of lodging. If sorghum is to be grown successively for silage on a field for more than three years, the potash should be increased to at least 80 pounds per acre.

In the Delta Area apply 60 to 80 pounds of nitrogen per acre at or prior to planting. Phosphate and potash generally are not needed in this area.

Varieties: C. P. 36-111. On deep, well drained soils of light texture.

Seeding Dates and Rates: Cut seed cane at the top mature joint and at ground level, but do not strip before planting. Plant in the fall (October 15) at the rate of 2 stalks, that is, place stalks end to end with a whole stalk at the union. Plant the cane in 4-foot rows on land that has been broken 5 to 6 inches deep a few weeks earlier. To protect from cold and to provide good drainage, cover the cane 6 to 8 inches deep by forming a ridge over it so that the drainage furrows between the rows are 2 to 4 inches deeper than the cane.

Fertilization: In the spring apply 40 to 50 pounds each of nitrogen and phosphate (P_2O_5) and potash (K_2O) per acre shortly after germination of the eyes, or just before re-growth from the stubble. Place the fertilizer in a band so that it will be 4 to 6 inches to the side of the row and 3 to 5 inches deep after the ridges have been worked down, or 1 to 2 inches deeper than the cane. Side dress with about 30 pounds of nitrogen per acre before July. Place side-dressing nitrogen in the edge of the root zone deep enough to be in moist soil without being disturbed by subsequent cultivation.

Strip, top, and cut the cane before freezing weather. Harvesting as much as a month before processing improves sirup quality and reduces "sugaring".

Grasses, Legumes, and Small Grains

(See Tables on next 6 pages)

Supplementary Information on Pasture Recommendations for the Hill Section

If equipment is available drill or row placement of seed and fertilizer is recommended for the establishment of all pasture and forage crops. With small-seeded legumes and grass care must be taken not to seed too deep. For established pastures, placement of fertilizer in the soil has no advantage over surface topdressing.

Where conditions are especially favorable for legumes, the danger of bloat may prevent full utilization of legumes seeded alone or of grass-legume combinations such as Dallisgrass and white clover, particularly in the Deep Loess area. The drilling of small grains or ryegrass into such a pasture will lessen the bloat problem and supply additional forage.

Because of the wide variety of soils to which theses pasture recommendations will be applied, and of the extensive nature of the typical commercial livestock operation in Mississippi, particularly beef cattle, the pasture fertilizer recommendations are generally presented as a range instead of a single and more arbitrary figure.

The lower limit of the recommendation is estimated to be sufficient for plant establishment and (1) for reasonable yields of forage on soils well adapted to the particular pasture crop under consideration, (2) for periods of economic stress during which it is still necessary to maintain a reasonable supply of cheap forage, and (3) where acreage per animal unit is not a serious limiting factor.

The upper limit of the fertilizer recommendations continues to be the agronomic optimum and should be used where the (1) soil type, (2) management system, (3) type of livestock enterprise, and (4) economic trend are such as to justify the considerably higher yields of forage that result from its use.

For winter growing grass-legume combinations, the amount of nitrogen used and the time of application depends primarily upon when grazing is needed and upon the desired proportion of grass and legume. Although there is very little difference in the total season's production of forage, fall applications speed plant establishment, increase fall and winter yields, and tend to provide a more favorable grass-legume ratio. For milking cows, lambs and other classes of livestock or system of managements where fall and winter grazing is important, and where danger of bloat exists, the application of 30-60 lbs. N at planting time is recommended.

The yields of grass forages is greatly increased by the application of nitrogen and where weather conditions do not limit growth excellent response is obtained to high rates of nitrogen; therefore, the most economical rate will depend upon temperature, availability of moisture, and the use made of the additional forage.

To increase the utilization of the nitrogen or to obtain a more favorable distribution of pasture production, split applications of nitrogen are recommended for both summer and winter grass pastures, with 30 to 60 pounds being applied each time. Except for coastal bermudagrass where the last application may be as late as September 1, the last application of nitrogen to permanent summer pastures should be made before August 1, and two weeks earlier if anhydrous ammonia is used. Because of the increased frequency of drought, mid-summer applications of nitrogen are generally less effective than applications made in the spring and early summer.

If irrigated, it may be economical to apply 120 pounds of nitrogen per acre to millet and sudangrass; 120 pounds to common Bermudagrass, Dallisgrass, and Bahiagrass, and 250 pounds to Coastal Bermudagrass pastures.

For summer temporary grazing crops, all the nitrogen should be applied 4 to 5 inches deep whether before planting or as a side dressing. Surface applications followed by dry weather may be of little value.

For winter growing grass or grass-

RECOMMENDATIONS FOR PASTURE, FORAGE AND GRAIN CROPS IN HILL SECTIONS****

Pasture Crop	Recommended Varieties	Time of Planting	Rate of Seeding per Acre	Fertilization, lbs./A annual application except lime
		GRASS LEGUME COMBINATIONS		
Dallisgrass lespedeza	Dallisgrass; domestic imported. Lespedeza: Kobe, common, climax	Dallisgrass: Feb.-Apr.; Aug.-Oct. Lespedeza: Feb.-Mar.	10 lbs. Dallisgrass, (live seed) 15 lbs. lespedeza	**Establishment:** 1 to 4 tons lime*, 60-100 lbs. P_2O_5, 40 to 60 lbs. K_2O. **Maintenance:** 40 to 60 lbs. P_2O_5, 40-60 lbs. K_2O.**
Dallisgrass-clover	Dallisgrass: domestic imported. White clover: Ladino, La. S-1, or other adapted strains	Dallisgrass: Feb.-Apr., Aug.-Oct. White clover: Sept. 1-Oct. 15	10 lbs. Dallisgrass (live seed) 2 lbs. white clover	Same as above
Ryegrass clover	Ryegrass: domestic, Italian American, Annual, Clover: Ladino, La. S-1, or other adapted strains—common and reseeding crimson	Sept. 1-Oct. 15	20-25 lbs. ryegrass 2 lbs. all varieties white clover, or 20-25 lbs. Crimson clover	1 to 4 ton lime*, 0-60 lbs. N, 60 to 100 lbs. P_2O_5, 30 to 60 lbs. K_2O**
Small grain and clover	Small grain: oats, wheat, rye, barley. Clover: Ladino, La. S-1, or other adapted strains—common and reseeding crimson	Sept. 1-Oct. 15	90 lbs. small grain; 2 lbs. all varieties white clover, or 20-25 lbs. all crimson clover	Same as above
Tall Fescue & white clover	Tall fescue: Alta, Goar, Kentucky 31. White clover Ladino, La. S-1, or other adapted strains	Sept. 1-Oct. 15	2 lbs. clover 5-10 lbs. fescue	1 to 4 tons lime*, 0-60 lbs. nitrogen (N) 60-100 lbs. phosphate (P_2O_5), 50 to 80 lbs. potash (K_2O)**

LEGUMES

Lespedeza	Kobe, Climax, common	Feb.-March	25 lbs.	1 to 4 tons lime*, 40 to 60 lbs. P_2O_5, 30 to 60 lbs. K_2O**
Lespedeza-sericea		Feb.-July 1	30-35 lbs. (hulled)	Same as above
Austrian winter peas		Sept. 1-Oct. 15	50 lbs.	Same as above
Rough peas	Also known as Wild Winter Peas, Caley peas, Singletary pea	Sept. 1-Oct. 15	50 lbs.	Same as above
Kudzu		Before May 1	500-1000 crowns	Same as above
Vetch	Hairy	Sept. 1-Oct. 15	30 lbs.	Same as above
Crimson clover	Common and reseeding	Sept. 1-Oct. 15	20-30 lbs.	Same as above. For seed production add 5-10 lbs. borax
White Clover	Ladino, La. S-1, or other adapted strains	Sept. 1-Oct. 15	2 lbs.	Same as for Dallisgrass lespedeza except 5 to 10 lbs of borax for seed.
Red Clover	Kenland and common	Sept. 1-Oct. 15	8-10 lbs.	**Establishment:** 1 to 4 tons lime*, 60 to 100 lbs. P_2O_5, 60 to 100 lbs. K_2O. For seed 5 to 10 lbs. borax. **Maintenance:** 40 to 60 lbs. P_2O_5, 40 to 60 lbs. K_2O. For seed 5 to 10 lbs. borax.**
Alfalfa	Buffalo, Ranger, Atlantic, Williamsburg, and Narragansett	Sept. 1-Oct. 15	20 lbs. per acre	**Establishment:** 1 to 4 tons lime*, 150-200 lbs. P_2O_5, 150 to 200 lbs. K_2O, 10 lbs. borax. **Maintenance:** 60-80 lbs. P_2O_5, 120 to 160 lbs. K_2O, 10 lbs. borax.**

(Continued on page 16)

RECOMMENDATIONS FOR PASTURE, FORAGE AND GRAIN CROPS IN HILL SECTIONS****—(Continued)

Pasture Crop	Recommended Varieties	Time of Planting	Rate of Seeding per Acre	Fertilization, lbs./A annual application except lime
		GRASSES		
Dallisgrass	Domestic, imported	Feb.-April; Aug.-Oct.	10 lbs. (live seed)	Lime*. 60 to 100 lbs. N in split applications, 30 to 60 lbs. P_2O_5, 30 to 60 lbs. K_2O.**
Bahiagrass	Pensacola, Argentine, Tifhi, domestic (southern 1/3 of state)	Feb.-April; or Aug.-Oct.	15 lbs./A	Same as above
Bermudagrass	Common	Feb.-May	5 lbs. seed or one clump every three feet	Same as above
Rescuegrass	Lamont	Sept. 1-Oct. 15	30-40 lbs.	Same as above
Tall fescue	Alta, Kentucky 31	Sept. 1-Oct. 15	5-10 lbs.	Same as above
Ryegrass	Italian, annual, domestic, American	Sept. 1-Oct. 15	20-25 lbs.	Same as above
Millet	Pearl, Cattail Starr, Gahi	Seeded by June 15	10 lbs. in rows, 25 lbs. broadcast	Same as above
Bermudagrass	Coastal	Feb.-May	[redacted] one clump every three feet	Lime*, 100 to 150 lbs. N, 50 to 70 lbs. P_2O_5, 50 to 70 lbs. K_2O**.
Sudan	Sweet, Greenleaf, Tift	Seeded by June 15	10 lbs. in rows, 25 lbs. broadcast	Same as for Dallisgrass

Oats	NORTH MISSISSIPPI: Delta Red 88, Nortex 107, Delair, Mid-South, Victorgrain 48-93*** Mustang*** Arlington*** SOUTH MISSISSIPPI: Delta Red 88, Nortex 107, Camellia, Suregrain and Moregrain	For Forage: Sept. 1-Oct. 1 For Grain: Oct. 1-Oct. 15	For Forage: 128 lbs. (4 bu.) For Grain: 96 lbs. (3 bu.)	For Forage: Maintenance Lime*, 60 lbs. nitrogen (N). 60-120 lbs. phosphate (P_2O_5). 30 lbs. potash (K_2O). Topdress in February with 60 lbs. N. For grain: 20 lbs nitrogen, 20 lbs. phosphate and 20 lbs. potash at seeding. Topdress with 40 lbs. nitrogen about March 1.**
Rye	Elbon Explorer (Gator and Florida Black South Miss. only)	Same as Oats Same as Oats	For Forage: 90 lbs. For Grain: 75 lbs.	Same as above Same as above
Wheat	NORTH & CENTRAL MISS.: Anderson, Chancellor, Atlas 66, Coker 47-27, Bledsoe SOUTH MISS.: Anderson Atlas 66, Coastal, Bledsoe	Same as for Oats Same as for Oats	For Forage 90 lbs. For Grain: 75 lbs.	Same as above Same as above
Barley	NORTH & CENTRAL MISS.: Kenbar, Pace, Dayton	Same as for Oats	For Forage 90 lbs. For Grain: 75 lbs.	Same as above; barley is very sensitive to strongly acid soils.
Grain sorghum	Hybrids, white grain: RS 630, DeKalb D55. Hybrids, Red Grain: RS 610, DeKalb C44a, P.A.G. 425S, P.A.G. 515-S, NK 230, Texas 620, DeKalb E56a, RS 501	Apr. 25-July 15	6-9 seeds per foot of 38-40'' row (6-9 lbs. per acre)	60-90 lbs. nitrogen, 30 lbs. phosphate, 30 lbs. potash at planting time.

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*See section on soil pH and liming for recommendations as to rate of lime to apply to different soils and crops in the absence of a soil test or other knowledge of the lime statue of the soil.

**Or the appropriate quantity of any mixed fertilizer which contains this ratio of nitrogen (N), phosphate (P_2O_5) and potash (K_2O).

***These oat varieties are susceptible to Victoria blight, and should not be planted too early in Central Mississippi unless the planting is made on land which has not grown oats for at least two years.

****On land adapted to that particular crop.

RECOMMENDATIONS FOR DELTA PASTURE AND GRAIN CROPS

Pasture Crop	Recommended Varieties	Rate of Seeding per Acre	Fertilizer	Time of Planting
Alfalfa	Buffalo, Kansas, Common Oklahoma Common	10-20 lbs.	Test soil for lime, phosphorus and potash. Apply minerals prior to planting and work into seedbed	Oct. 1-15
Bermuda Grass	Common Coastal (Irrigated)	5 lbs. Sprig	60 lbs. nitrogen June 1 180 lbs. nitrogen (4 applications 45 lbs. each, June 1 and each 30 days)	Mar. 1-May 1 Nov. 1-May 1
Dallisgrass	Imported or Domestic	10 lbs. Live Seed	30 lbs. nitrogen June 1	Mar. 1-May 1
Fescue and Ladino	Kentucky 31	5-10 lbs. Fescue 1-2 lbs. Ladino	30 lbs. nitrogen at planting 60 lbs. nitrogen September 1 for winter grazing	Oct. 1-Nov. 1 Feb.-May 1
Red Clover	Kenland Common	10-15 lbs. seed alone or in small grains	Test soil for lime, phosphorus and potash	Oct. 1-Nov. 1
Ladino Clover		1-2 lbs. seed with grass	Test soil	Oct. 1-Nov. 1
White Clover		2-4 lbs. seed with grass	Test soil	Oct. 1-Nov. 1
Crimson Clover	Hard seeded for volunteer crop	12-15 lbs.	Test soil for lime, phosphorus, and potash	Oct. 1-Nov. 1
Sudan grass	Tift, Greenleaf	6-10 lbs. in 38" to 40" rows	60 lbs. nitrogen prior to planting	June 1-20
Lespedeza	Korean or Climax	20-25 lbs. seed in small grains		Feb. 15-Mar. 15
Grain sorghum	DeKalb E56a & D50a, RS 610	6 to 8 lbs. in 38" to 40" rows	90 to 120 lbs. nitrogen prior to planting	April 20-July 10
Oats	Delta Red 88 Nortex 107 Arlington, Mustang, Delair, Victorgrain 48-93, Midsouth	3 bu. for grazing 2 1/2 bu. for grain	60 lbs. nitrogen in Sept. for winter grazing 45 to 60 lbs. nitrogen Feb. 20-Mar. 15 for grain	For grazing early September For grain, mid-October
Wheat	Chancellor, Atlas 66, Coker 47-27, Anderson, Bledsoe, Knox	1 1/4 bu. for grain 1 1/2 bu. for grazing	Same as for oats	Same as oats
Rye	Explorer	1 1/4 bu. for grain 1 1/2 bu. for grazing	Same as for oats	Same as for oats
Barley	Kenbar, Pace, Dayton	75 lbs. for grain 90 lbs. for grazing	Same as for oats	Same as for oats Plant only on well drained sandy soil

Ryegrass	Annual	25-30 lbs.	60 lbs. nitrogen prior to planting 60 lbs. nitrogen in March	Sept. 1-30
Johnson grass and red clover mixture		10-15 lbs. spring 10 lbs. fall	60 lbs. nitrogen June 15	April 1-June 1 Oct. 1-Nov. 1 after Johnson grass established

RECOMMENDATIONS FOR LAWNS AND OTHER TURF AREAS

Grass	Recommended Varieties	Method of Planting	Rate of Planting	Fertilization per 1000 Sq. Ft. per Year
Bermudagrass	Common Tiflawn, Sunturf, Ormond Tifgreen	Seed or sprig sprig	2 lb./1000 sq. ft. sprig on 6-12 in. rows	9 lbs. nitrogen, 3 lbs. P_2O_5 3-4 lbs. K_2O, split into 4 applications
Zoysia	Emerald, Matrella, Meyer	Sprig or plug	Sprigs or plugs 6 in. apart on 6 in. rows	5 lbs. N 2-3 lbs. P_2O_5 2-3 lbs. K_2O split into 2 applications
St. Augustine	Common, Floratine	Sprig	Sprig on 6-12 in. rows	Same as Zoysia
Centipede		Seed or sprig	4 oz./1000 sq. ft. sprig on 6-12 in. rows	2 lbs. N 1-2 lbs. P_2O_5 1-2 lbs. K_2O split into 2 applications
Carpet		Seed or sprig	5 lb./1000 sq. ft.	Same as Centipede
Bahia	Argentine, Pensacola, Paraguayan	Seed	5 lb./1000 sq. ft.	Same as for Zoysia
Ryegrass	Italian	Seed	5-10 lb./1000 sq. ft.	1 lb. N/1000 sq. ft. in January if needed

legume pastures that are seeded late and from which no fall or winter grazing can be expected, the initial nitrogen application may be delayed until growing conditions are more favorable.

Fall application of phosphorus or potash is recommended if these elements are necessary to establish legume seedlings in the fall. However, spring application is more effective for spring and summer growth of perennial plants and those which come up in the spring. In general, fertilizers should be applied as close as practical to the time they are to be used by plants.

Supplementary Information for Lawns and Other Turf Areas

Use the best adapted grass. Bermudagrasses do not survive in the shade, but Zoysia, St. Augustine and Centipede do. In areas where the chinch bug makes the growing of St. Augustine difficult, change to another adapted grass. Tiflawn Bermudagrass, due to its high recovery from use, is excellent on athletic fields and other play areas. Tifgreen Bermudagrass is recommended only for areas that will receive the best of management, such as golf greens and excellently-cared-for lawns.

New turf areas should have nitrogen, phosphorus and potash worked into the top six inches of the soil prior to planting seed or vegetative material. Established turf areas should be fertilized regularly using a broadcast method of application. For best results begin fertilization of established turf areas in the early spring and continue until late summer. Caution should be exercised when applying fertilizers containing inorganic nitrogen materials to prevent damage to the grass. In any event, fertilized areas should be watered immediately after fertilization to wash fertilizer off the grass leaves and into the soil.

Proper mowing techniques, watering, weed, insect and disease control are also important in a turf management program. To keep turf in a vigorous state of growth, management in all its aspects is important.

Horticultural Crops

FERTILIZER RECOMMENDATIONS FOR ORNAMENTALS

Soil tests are recommended. If they are not available, then use the following recommendations

Plant	Number of Applications	Time of Application	Fertilizer*	Rate*	Remarks
Shade Trees					
Trunk Diameter under 6 in.	1	Oct. to March	12-8-8	1 lb./in. trunk diameter	Fertilize at least every 3 years. Distribute in holes 12 in. deep, spaced evenly within branch spread, and use 20 holes/inch of tree diameter.
Trunk Diameter over 6 in.	1	Oct. to March	12-8-8	2 lbs./in. trunk diameter	
Shrubs and Flowers	1	Spring	6-8-8	2-4 lbs/100 sq. ft.	Use 1-2 lbs. per plant for specimen shrubs.
Commercial Crops or for special plants	Write for details on specific crops				

*Equivalent amounts of N-P-K may be applied by other materials.

FRUIT

Apple

Early Harvest, Lodi, Williams Early Red, Golden Delicious, Red Delicious, Stayman Winesap.

Pear

Ayres, Orient, Morgan, Garber, Waite, Kieffer.

Plum

Methley, Munson, America, Santa Rosa.

Peach

Central and North Miss.—Dixired, Dixigem, Redhaven, Triogem, Halehaven, Sullivans Early Elberta, Georgia Belle, Elberta, Afterglow.

South Miss.—Robin, Hiland, Maygold, Keystone, Sunhigh, Hiley, Southland, Redskin.

Pecans

Stuart, Desirable, Farley, Lewis.

Only in South Miss.—Elliot, Curtis.

Strawberries

South Miss.—Headliner, Klonmore.

Elsewhere—Blakemore, Dixieland, Pocahontas, Albritton.

Blackberries

Thornless Boysen (trailing), Flint (erect).

Raspberries

Sodus (purple), Mandarin or Sunrise (red), Manteo (black), Golden or Queen (yellow).

Muscadines

Black—Hunt, *Burgaw, Dulcet, Thomas, *Magoon.

Bronze—Scuppernong, *Wallace, Topsail, *Dearing, Higgins.

Bunch Grapes

Concord or Champanel (blue), Delaware or Salamander (red), Niagara or Portland (white).

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*At least one of these pollinator vines must be included with all plantings.

FERTILIZERS FOR FRUIT CROPS

Recommendations are for annual applications on soils of average fertility where clean cultivation is practiced in the summer. Equivalent amounts of higher analysis fertilizers may be used. Soil samples in commercial orchards may indicate need for different ratios. Commonly in the Delta area, only nitrogen fertilizer is need.

Tree Fruits	Grade	Pounds per tree per year of age
Applied under tree branches before growth begins in spring.		
Apples, Pears	6-8-8	1
If trees blight seriously, nitrogen fertilizer can be reduced or omitted. Maximum rates should be reached at 15-20 years.		
Peaches, Plums	6-8-8	1
	16% N	½
Apply two-thirds of N fertilizer before growth begins and one-third in June or July. Maximum rates should be reached at 6 to 10 years.		
Pecans	6-8-8	2-3

Small Fruits	Grade	Lbs. per acre
Strawberries (Central and North Mississippi)		
February	6-8-8	300-500
June	6-8-8	300-500
September	6-8-8	300-500
In South Mississippi apply 6-8-8 at rate of 6-10 pounds per 100 feet of row before setting plants and 3 to 5 pounds per 100 feet of row in January.		
Blackberries, Dewberries, Raspberries		
February	6-8-8	300-500
June	6-8-8	300-500
	16% N	200
	6-8-8	1-6 lbs. per vine

VEGETABLE VARIETY AND FERTILIZER RECOMMENDATIONS

The variety and fertilizer information supplied here is made on the basis of tests throughout Mississippi. The varieties listed are suitable for both home garden and commercial purposes unless otherwise designated. Vegetables as a group require more fertilizer per acre than most other crops. The fertilizer recommendations are suggested for all areas of the state except in the Delta area where on most soils nitrogen fertilizer may be all that is required. For problem soils, or for specific recommendations for individual farms, the Mississippi Soil Testing Service is recommended. This is especially true where the soil reaction (pH) is not known, since many vegetable crop failures are due to improper liming.

			FERTILIZERS **Pounds per Acre**		
CROP	VARIETY	pH	N	P_2O_5	K_2O
Asparagus	Mary Washington	6.0-7.0	50	100	100
			After cutting season topdress with		
			25	50	50
Beans and Peas		5.8-7.0	50	100	50
Bush Lima			Sidedress in full bud stage with		
Small seeded	Clark's Bush Henderson, Thaxter, Nemagreen**		32	0	0
Large seeded	Fordhook 242				
Colored seeded	Jackson Wonder				
Pole type lima	Carolina Sieva, Willow Leaf				
Bush snap	Longval, Contender (oval) Extender, Wade (round) Top Crop				
Pole snap	Kentucky Wonder Blue Lake				
English Pea	Thomas Laxton, Wando, Little Marvel				
Southern Pea	Mississippi Crowder, Bunch Purple Hull, Dixilee, Monarch	5.8-7.0	30	40	40
Broccoli	Texas 107, De Cicco, Green Mountain	5.5-6.5	75	100	100
			20-40 lbs. borax. When heads begin to form sidedress with		
			32	0	0
Cabbage	Round Dutch, Early Jersey Wakefield*				
Cauliflower	Snowball-E and/or -M				
Collard	Vates, Morris Heading				
Mustard	Florida Broadleaf, Giant Southern Curled	5.5-6.5	48	48	48
			Sidedress with		
Radish	Cherry Belle, Scarlet Globe, White Icicle (long)		32	0	0
Turnip	Purple Top White Globe Shogoin (greens)				
Beet	Detroit Dark Red, Crosby Egyptian	6.0-7.0	75	100	100
			Sidedress with		
Carrot	Gold Spike, Touchon, Imperator		32	0	0

(Continued)

Spinach					
Savoy	Bloomsdale Long Standing, Old Dominion				
Smooth	Viroflay, Hybrid No. 7 or 10				
Cantaloupe	Rio Gold, Edisto, Hales Best No. 36, Homegarden*	5.5-6.5	40	80	80
			When plants begin to run sidedress with		
Cucumber					
Slicing	Ashley, Palmetto		30	30	30
Pickling	Model				
Squash	Early Summer Crookneck, Early Prolific Straightneck, White Bush Scallop				
Watermelon	Blackstone, Shipper, Charleston Gray				
Eggplant	Florida Market, Black Beauty	5.5-6.0	75	100	100
			Sidedress with		
Irish Potato	LaSoda, Katahdin, Kennebec		32	0	0
Pepper, Bell	Early Calwonder, Yolo Wonder B, Keystone Resistant Giant				
Pepper, Hot	Long Red Cayenne	5.5-6.0	40	80	80
Pepper, Pimiento	Truhart Perfection		Sidedress with		
			30	30	30
Tomato		6.0-7.0	60	120	60
Red	Marion, Kokomo,		Sidedress with		
	Rutgers, Big Boy Hybrid		40	40	40
Pink	Pink Shipper				
Greenhouse Production	Globelle Tuckcross O or V				
Lettuce,		6.0-7.0	75	100	100
Leaf	Grand Rapids,		Sidedress with		
	Salad Bowl		32	0	0
Head	Great Lakes				
Okra	Emerald, Clemson Spineless, Louisiana Green Velvet	6.0-6.5	60	80	80
			Sidedress with		
			20	0	0
Onion	Grano, Granex, Multiplier	6.0-7.0	50	100	100
			Sidedress with		
			50	0	0
Sweet Corn	Aristogold Bantam Evergreen, Golden Security	5.5-6.5	30	40	40
			Sidedress with		
			64	0	0
Sweetpotato	Goldrush, Centennial, Unit I Porto Rico	5.0-6.0	40	80	80

*Home Garden only. **For areas where nematodes are a problem.

TUNG

Varieties: Isabel (L-2), Folsom (L-47), Gahl (L-51), La Crosses (F-99), and Lampton (F-578).

Fertilization: Apply fertilizer to non-bearing tung trees shown in Table 1. Fertilize newly planted trees after growth starts, spreading the mixture evenly in bands about 6 inches wide, the inner edges of the bands about 12 inches from the tree trunks. In the second year after planting and subsequently, spread the fertilizer evenly under the spread of the branches shortly before or when growth starts.

Fertilize bearing trees as soon as possible after they blossom, adjusting rates to the estimated yield as shown in Table 2. Specific modifications of these recommendations appropriate for individual orchards can be made on the basis of leaf analyses by Experiment Station or U.S.D.A. Tung Laboratory personnel, who will furnish instructions for sampling leaves.

If a major portion of the crop is lost by frost, applying a low level of nitrogen will tend to minimize biennial bearing. However, uptake of potassium from the soil is slow, even in a year of light or no crop, at least 50 pounds of K_2O per acre is required to maintain the trees in healthy condition and insure good oil content in the fruit of the following year when a heavy crop is to be expected.

Usually it is more economical to apply the nitrogen as anhydrous ammonia, aqua ammonia, or ammonium nitrate, and the phosphorus and potassium as 0-10-3 or superphosphate and muriate of potash than to apply a complete mixed fertilizer. If inadequate zinc is indicated by leaf analysis or symptoms apply 2 oz. of commercial zinc sulphate per tree, preferably mixed with solid fertilizer. Apply all solid fertilizers in bands 4 to 5 feet wide on each side of the tree row and cultivate to incorporate it in the soil.

Table 1. Fertilizer requirements of non-bearing tung trees.

Year in the orchard	Fertilizer formula	Amount (lbs./tree)
First (newly planted)	5-10-5	1
Second	5-10-5	1½
Third	10- 5-10	2½

Table 2. Approximate requirements of nitrogen, phosphorus, and potassium in relation to yield of bearing tung trees.

Estimated yield	N	P_2O_5	K_2O
Tons per acre		Lbs. per acre	
0 to 1	0 to 50	25	50 to 75
1 to 2	50 to 80	40	75 to 125
2 or more	80 to 120	60	125 to 175

BULLETIN 611 JANUARY 1961

MISSISSIPPI
COTTON VARIETY TESTS
FOR 1960

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
CLAY LYLE, Director

STATE COLLEGE MISSISSIPPI

JUN 17 1961

THE AUTHORS

DELTA TESTS — James B. Dick and H. H. Ramey, Jr.

HILL SECTION TESTS — G. D. Green, R. E. Coats, S. P. Crockett, B. C. Hurt, B. F. Waggoner, and L. B. Walton

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SOURCES OF SEED IN 1960 TESTS

Acala 4-42: Bred in California. Our seed from Delta Branch Station, Stoneville, Miss.

All-In-One: W. W. Wannamaker Seed Farms, Inc., St. Matthews, South Carolina.

Auburn 56 and Plains: Ala. Agri. Exp. Station, Auburn, Alabama.

Coker, all strains: Coker's Pedigreed Seed Co., Hartsville, South Carolina.

DeKalb 108: DeKalb Agri. Assn., Inc., Bogart, Georgia.

Delfos and Stoneville, all strains: Stoneville Pedigreed Seed Co., Stoneville, Miss.

Deltapine, all strains and Fox 4: Delta and Pine Land Co., Scott, Miss.

DES 1030: Delta Branch Experiment Station, Stoneville, Mississippi.

Dixie King, all strains: Bobshaw Pedigreed Seed Co., Indianola, Mississippi.

Empire: Empire Pedigreed Seed Co., Haralson, Georgia.

Lankart 57: Bred in Texas. Our seed from Delta Br. Exp. Sta., Stoneville, Miss.

Pope: Tenn. Agri. Exp. Station, Knoxville, Tennessee.

Rex: Cotton Branch Experiment Station, Marianna, Arkansas.

Stardel: Louisiana Agri. Experiment Station, Baton Rouge, Louisiana.

Mississippi Cotton Variety Tests For 1960

IN THE DELTA

Cotton variety trials were conducted by the Delta Branch Experiment Station during 1960 in the alluvial Yazoo-Mississippi Delta at Stoneville, Tunica, and Yazoo City. Tests planted at Clarksdale, on the Williams Plantation 5 miles north of Clarksdale, and on the Ware farm west of Marks were not harvested for yield because of poor stands. Seedling disease complex was especially severe in the Clarksdale test on the Heaton Plantation and also caused some damage on the Williams test.

The 1960 season varied widely over the Delta but, as a whole, was considered fairly good for cotton production. In many areas the period of June, July and early August was deficient in rainfall, but not excessively hot. Supplemental irrigation was used to excellent advantage whereever available.

Rainfall after August 5 varied from 3 inches at Tunica to 17 inches in immediate vicinity of Yazoo City. At Stoneville the drought was broken on August 10 and 11 by 2.40 inches of rainfall. From August 10 to September 1 at least a trace of rain was recorded on 17 days for a total of 7.05 inches. This entire period was one of low sunlight intensity which resulted in heavy shedding and excessive new growth which later proved very difficult to remove with defoliants. Boll rot damage in late August and early September was very severe. Maturity and opening was delayed considerably by these conditions which prevailed throughout much of the Delta.

Yields are estimated as 545 pounds for the upper Delta and 510 pounds for the lower Delta, or an average Delta production of 527 pounds of lint per acre. The Delta average yield was 617 pounds in 1959 and 440 pounds in 1958. September, October and November provided fairly good harvesting weather, with 3.20 inches of rainfall on 8 days of September, 2.72 inches on 8 days during October, and 3.80 inches on 6 days during November. A light frost on October 20 did little damage, but a killing frost and 25 degree temperature on November 10 stopped all plant developments.

Current strains of 13 commercial varieties and one Delta Station Smooth Leaf strain were used in 1960 tests. At Stoneville and Tunica California Acala 4-42 and Texas Lankart 57 were added. The Stoneville study also included DeKalb 108 and three Station strains.

Table 1 gives results of the yield trial at the Delta Station. The test was planted on April 22 and resulted in excellent emergence and uniform stands. Seasonal conditions have been described above. Insect control was very good. Due to the damage from rain and low light intensity during August and excessive early boll rot, no attempt was made to determine earliness by a first picking. The entire crop was harvested on October 14 with the seed cotton from each plot being run through an overhead cleaner to remove the burs and trash before recording plot weights. Yields ranged from 500 to 900 pounds of lint per acre with an overall average of 666 pounds. The average yield on the same area in 1959 was 1180 pounds. Lint percents were higher and staples shorter than normal. Tensile strength (T_1) was very good, and the micronaire showed the fiber as coarser than normal. Boll rot in Lankart 57 was quite severe. Most of the bolls of all varieties were

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[1] Agronomist, Cotton & Cordage Fibers Research Branch, Crops Research Division, ARS, USDA, and Geneticist, Mississippi Agricultural Experiment Station. This report is based upon results from cooperative research conduced by the Mississippi Agricultural Experiment Station and Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture.

open before harvesting. As a rule the big boll cottons and earlier varieties yielded less than the intermediate varieties.

Table 2 gives results of the yield trial conducted on Woolfolk Plantation about 6 miles northeast of Tunica. A planting was made on May 12 in cold soil. Emergence and survival were uneven, with some damage from seedling disease. Spot planting was necesary in all varieties, with very good resulting final stands. June and July were dry. Supplemental irrigation was used one time in July. A total August rainfall of 3 inches supplied further moisture but did not induce objectionable re-growth. Bottom defoliation and ordinary application of defoliants were used to excellent advantage. A first picking was made on October 13 with final harvest on November 15. Because of uneven ages of plants no attempt was made to calculate earliness. Very little boll rot was observed except in Lankart 57. A few bolls of Acala 4-42 were frost damaged and did not open. Lint yields ranged from 1400 pounds for Stoneville 3202 to 878 pounds for Lankart 57, with an overall average of 1207 pounds. Lint percentages were somewhat low. Staple length, fiber strength, and micronaire index were about normal.

Table 3 gives the data from the outlying variety trial on the Shaeffer Plantation, 2 miles northwest of Yazoo City on the Yazoo River. The test was first planted on April 20. Due to poor emergence and seedling disease it was replanted throughout on May 13, with resulting good stands. A June and July drought was broken on August 5 by 4 inches of rain accompanied by a wind storm. Total rainfall during August was 17 inches. This resulted in heavy shedding, boll rot and regrowth, particularly in April planted cotton. Cotton in test plots had rank growth, considerable boll rot, and some grass. All plots were harvested on October 12. The seed cotton was run through a small cleaner to remove burs and trash before taking plot weights.

Tables 1 through 3 present the results of the three variety-yield trials. Yield of seed cotton and lint per acre, lint percentage, and fiber properties of staple length, strength (T_1) and micronaire are given. The last column in each table gives the gross money value per acre for each variety. This value is computed by using the purchase price of Option A cotton, Strict Low Middling grade, for the staple length of the variety times the pounds of lint per acre, plus the seed at $40 a ton. Strict Low Middling is used as it best reflects the average grade obtained on most plantations. Varieties are listed in each table in order of dollar value per acre. This order follows closely the order of pounds of lint per acre, the exceptions being varieties with lower lint percentages and more seed.

Table 4 shows the average lint percentages, staple lengths, fiber strengths, and micronaires for 14 varieties for all tests. Lint percentages range from 34.6 for Delfos 9169 to 40 for D&PL Smooth Leaf and 39+ for DES 1030, Stoneville 7 and Deltapine 15. Classers staple lengths averaged from 1 1/32 inches for Rex and Stoneville 3202 to 1 1/16.. for Delfos 9169. Fiber strength or Tenacity (T_1) as determined by the Stelometer at 1/8 inch gauge is relative. By this measure Acala 4-42 and Stardel have stronger fiber than other varieties. Rex, Stoneville 3202 and Iankart have weak fibers. Fineness as measured by the Micronaire, ranged from 4.42 for Delfos 9169 and 4.50 for DES 103 and Empire to the rather coarse fibered D&PL Smooth Leaf, Fox 4, Stoneville 7 and Lankart. All varieties had higher Micronaires in 1960 than in 1959, but still fell in the acceptable range of fineness.

Yield data were obtained from replicated and randomized plots in each test. Other data were determine from samples taken from the plots at harvest. Classing was done by the Staple Cotton Coop-

Table 1. Yield, lint percent, bolls per pound, staple length, strength, elongation, micronaire, and gross value per acre for the 1960 cotton variety test at Stoneville, Mississippi.

Variety	Yield per acre		Per-cent lint	Number bolls per pound		Fiber properties					Gross value per acre SLM
	Seed cotton	Lint		Seed cotton	Lint	Staple length		Strength T_1	Elonga-tion E_1	Micro-naire	
						Classer	UHM				
	lbs.	lbs.	pct.	no.	no.	inch	inch	index	index	index	dollars
Stoneville 7	2173	900	41.4	77	186	1 1/16—	1.12	1.82	6.7	5.42	$304
D&PL Smooth Leaf	2094	844	40.3	77	191	1 1/16—	1.12	1.94	7.4	5.12	287
Coker 100A	1947	720	37.0	71	192	1 1/16—	1.11	1.93	6.4	4.82	250
Deltapine 15	1800	730	40.6	79	195	1 1/16—	1.10	1.98	8.5	5.06	248
DeKalb 108	1952	728	37.3	68	182	1 1/32	1.13	1.82	7.0	4.77	248
DES 723 Smooth Leaf	1726	720	41.7	79	190	1 1/16—	1.08	1.94	7.7	4.95	243
D&PL Fox 4	1824	702	38.5	75	195	1 1/32	1.08	1.98	6.8	5.36	238
Auburn 56	1882	683	36.3	73	200	1 1/16—	1.08	1.88	7.1	4.67	236
DES 1030 Smooth Leaf	1721	675	39.2	85	217	1 1/16—	1.10	1.85	7.4	4.54	230
Coker 124C	1748	654	37.4	70	187	1 1/16	1.14	1.92	6.9	4.84	227
Delfos 9169	1873	640	34.2	64	188	1 1/16	1.14	1.84	7.1	4.34	225
Stoneville 3202	1729	660	38.2	77	200	1 1/32	1.03	1.63	6.6	4.62	225
Acala 4-42	1549	605	39.0	61	156	1 1/16	1.08	2.17	6.7	4.92	208
Dixie King	1593	580	36.4	60	166	1 1/16—	1.11	1.85	6.0	4.72	202
Rex	1609	587	36.5	66	180	1 1/32	1.09	1.60	6.7	4.61	201
Stardel	1450	560	38.6	80	208	1 1/32	1.10	2.08	5.8	4.85	191
Empire	1443	505	35.0	58	166	1 1/16—	1.09	1.86	5.6	4.28	175
Lankart 57	1230	500	40.6	54	134	1	1.01	1.67	8.7	5.16	164
Averages	1741	666	38.2	71	185		1.10	1.88	7.0	4.84	
LSD at 5%		158									

Planted April 22, harvested November 4.

Table 2. Yield, lint percent, staple length, strength, elongation, micronaire, and gross value per acre for the 1960 cotton variety test at Tunica, Mississippi

Variety	Yield per acre		Percent lint	Fiber properties					Gross value per acre SLM
				Staple length		Strength T₁	Elongation E₁	Micronaire	
	Seed cotton	Lint		Classer	UHM				
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
Stoneville 3202	3812	1398	36.7	1 1/32	1.10	1.60	7.5	4.50	$478
Coker 124 C	3848	1360	35.3	1 1/16	1.16	1.85	7.3	4.58	475
D&PL Smooth Leaf	3467	1326	38.3	1 1/16	1.19	1.87	8.0	4.86	459
Stoneville 7	3554	1310	36.9	1 1/16	1.18	1.70	7.4	5.00	455
Auburn 56	3655	1294	35.4	1 1/16—	1.11	1.80	7.4	4.75	452
D&PL Fox 4	3532	1258	35.6	1 1/16	1.18	1.94	7.1	4.88	439
Coker 100 A	3445	1222	35.5	1 1/16	1.19	1.90	7.6	4.63	427
Dixie King	3460	1222	35.3	1 1/32+	1.15	1.82	6.0	4.80	424
DES 1030 Smooth Leaf	3274	1242	37.9	1 1/32	1.12	1.70	7.3	4.50	423
Delfos 9169	3525	1177	33.4	1 3/32	1.20	1.83	7.5	4.30	418
Stardel	3245	1204	37.1	1 1/16	1.14	2.03	5.7	4.78	418
Acala 4-42	3136	1168	37.3	1 1/16—	1.16	2.12	7.0	4.48	401
Empire	3216	1109	34.5	1 1/32+	1.12	1.78	5.9	4.42	388
Rex	3154	1126	35.7	1 1/32	1.14	1.58	7.0	4.40	387
Deltapine 15	2697	1016	37.7	1 1/16	1.16	1.92	7.9	4.58	352
Lankart 57	2440	878	36.0	1	1.06	1.66	9.2	5.00	294
Averages	3340	1207	36.2		1.15	1.82	7.2	4.65	418
LSD at 5%		158							

Planted May 12, harvested October 13 and November 15.

Table 3. Yield, lint percent, staple strength, micronaire, elongation, and gross value per acre for the 1960 cotton variety test at Yazoo City, Mississippi.

Variety	Yield per acre		Percent lint	Fiber properties					Gross money value per acre
				Staple length		Strength T_1	Elongation E_1	Micronaire	
	Seed cotton	Lint		Classer	UHM				
	lbs.	lbs.	pct.	inch	inch	index	index	index	dollars
D&PL Smooth Leaf	1466	608	41.5	1 1/32	1.05	1.78	7.7	5.41	$204
Stardel	1448	573	39.6	1 1/16—	1.09	1.93	6.0	5.03	195
DES 1030 Smooth Leaf	1426	568	39.8	1 1/16	1.09	1.74	7.7	4.48	195
D&PL Fox 4	1465	560	38.3	1 1/32	1.06	1.81	7.0	5.34	191
Auburn 56	1425	533	37.4	1 1/32	1.02	1.80	6.3	5.07	182
Stoneville 3202	1338	520	38.9	1 1/32	1.01	1.62	6.4	4.85	177
Stoneville 7	1275	508	39.8	1 1/32	1.09	1.70	6.9	5.34	172
Coker 124 C	1309	500	38.1	1 1/16—	1.09	1.74	6.9	4.97	171
Delfos 9169	1272	462	36.3	1 1/16	1.14	1.81	6.9	4.62	161
Coker 100 A	1160	440	38.0	1 1/16—	1.05	1.80	6.3	5.05	151
Rex	1128	430	38.2	1 1/32	1.06	1.69	6.4	4.84	146
Deltapine 15	1084	430	39.7	1 1/16—	1.08	1.81	7.3	5.08	146
Dixie King	1024	382	37.3	1 1/16—	1.04	1.78	5.6	5.06	131
Empire	822	306	37.2	1 1/32	1.02	1.74	6.0	4.80	104
Averages	1260	487	38.6		1.06	1.77	6.7	5.00	166
LSD at 5%		123							

Planted May 13, harvested October 12.

erative Association in Greenwood, Mississippi, and the fiber properties data were determined by the fiber laboratory of the Crops Research Division, U. S. Department of Agriculture at Knoxville, Tennessee.

Table 4. Average lint percent, classer's staple length, upper half mean, fiber strength, elongation and micronaire of 14 varieties of cotton grown at three Delta locations in 1960.

Variety	Lint percent	Classer's staple length	Upper half mean	Fiber strength T_1	Elongation E_1	Micronaire
	pct.	inches	inches	index	index	index
Auburn 56	36.4	1 1/32+	1.07	1.82	6.9	4.83
Coker 100 A	36.8	1 1/16	1.12	1.87	6.8	4.83
Coker 124 C	36.9	1 1/16	1.13	1.84	7.0	4.80
Delfos 9169	34.6	1 1/16+	1.16	1.83	7.2	4.42
Deltapine 15	39.3	1 1/32+	1.11	1.90	7.9	4.90
D&PL Smooth Leaf	40.0	1 1/32+	1.12	1.86	7.7	5.13
Dixie King	36.3	1 1/32+	1.10	1.82	5.8	4.86
Empire	35.6	1 1/32+	1.08	1.80	5.8	4.50
D&PL Fox 4	37.5	1 1/32+	1.11	1.90	7.0	5.20
Rex	36.8	1 1/32	1.10	1.62	6.7	4.62
Stardel	38.4	1 1/32+	1.11	2.00	5.8	4.90
Stoneville 7	39.4	1 1/32+	1.13	1.74	7.0	5.25
Stoneville 3202	37.9	1 1/32	1.05	1.62	6.8	4.65
DES 1030 Smooth Leaf	39.0	1 1/32+	1.10	1.80	7.5	4.50
Acala 4-42[1]	38.1	1 1/16	1.12	2.15	6.9	4.70
Lankart 57[1]	38.2	1	1.04	1.67	9.0	5.08

[1] At Stoneville and Tunica only.

Cotton Tests In Hill Sections

Yields in these tests were good in 1960 but they were limited to some extent at all sections by dry weather.

Ranking of varieties according to yield shifted considerably from previous years. This again emphasizes the importance of studying average yields in addition to the last season's results when selecting a variety.

The importance of cotton as a high value crop may be seen by checking the dollar value per acre columns in the accompanying tables.

Seven tests were completed at the hill stations in 1960. All included the same 19 varieties and there were six additional ones at State College. Seventeen of these are commercial varieties seed of which will be available to farmers for planting in 1961. Coker LH 61M and DES 1030 are advanced breeders strains; seed are not available. Among the six additional entries at State College, Acala 4-42 is from California and Lankart 57 is from Texas. These were included in order to cooperate in a beltwide cotton variety test sponsored by the U. S. Department of Agriculture. Stoneville 508, Dixie King 3 and 45A and Coker LH 57-137 are breeders strains. Seed of all entries except Stardel were good. Our lot of Stardel showed symptoms of over-treatment. It produced such a poor stand at State College, Newton and Raymond that it was omitted from the reports.

The varieties were planted in single row plots in randomized complete blocks with six replications except at Holly Springs where eight replications were planted. Row length varied from 70 to 190 feet and the width was 40 inches except at Brookville where it was 42 inches.

Final stands at most locations were

fair to good but the tests at Newton and Holly Spring had to be planted over and the one at Verona was too skippy to use for yield record. Several days cool weather at or soon after planting resulted in lowered germination and considerable loss of young plants due to disease.

Seed of all varieties, except Acala 4-42 and Lankart 57, were supplied by the breeders of the varieties and were planted just as received. All had been machine delinted and treated. Seed of each variety in all tests came from the same bag.

Planting arrangements were made at and seed distributed from the Central Station, State College where the 100 boll samples were ginned and all calculations made. All other operations were performed at the respective stations. Samples of 100 well developed bolls of each variety were picked from each of three replications in each test. These samples were ginned separately on a 10-saw gin and the results averaged for lint percentage, staple length and boll size. Lint samples for strength and fineness tests also came from these samples.

Staple lengths reported are averages of the determinations of three professional cotton classers each representing a different organization and stapling samples from a different replication. Strength and fineness of fibers were determined for the State College test by a commercial fiber testing laboratory.

Lint prices used in calculating acre values for 1960 are Government Plan A prices for the West Point, Mississippi, area. In recent years, Memphis quotations were used. Seed were valued at $42 per ton. Strict Low Middling was used as the grade since it is close to the average grade for the Mississippi hill section crop. Corrections for skips were made for the excess over three feet per skip in the test at State College and Holly Springs.

Boll size, lint percentage and staple length were not far from average at most stations. However, bolls were smaller, lint percentage higher and staple shorter than average at Brooksville. At Newton, the lint percentage was higher, staple shorter and boll size larger than average.

The differences in yield between the higher and lower yielding varieties were considerable. When analyzed statistically, these differences were found to be highly significant at all locations except Newton and significant there.

Explanation of Tables

Yield and other data for 1960 and averages for five or fewer years are shown in the accompanying tables. Fertilizer used, soil type, planting dates and number of poison applications are shown in the footnotes of the 1960 tables for the respective stations. The varieties are arranged in order of lint yield per acre. The term LSD at 5% means Least Significant Difference with odds of 19 to 1 that the amount given is a real difference. The term CV means Coefficient of Variation and the smaller it is the better the test. Deltapine SL means Deltapine Smooth Leaf and DES 1030 is a strain of smooth leaf from the Delta Branch Experiment Station, Stoneville, Mississippi.

The percent picked at the first picking gives some indication of the relative earliness of the varieties and is reported for the State College and Holly Springs tests. Staple length is expresed in 32nds. inch. A staple of 32.0 is 1 inch, one of 33.0 is 1 1/32 inches and one of 31.0 is 31/32 inch, etc.

81 to 86 thousand pounds per square inch is considered strong, one of 87 to 92 very strong and one of 93 or above superior. The strength figures reported here are higher than usual. A fineness reading of 4.0 to 4.9 indicates average fineness and from 5.0 to 5.9 is classed as coarse. The figures reported here are about average for the 1960 crop which is good in this respect. A blank space in the averages tables means that variety was not tested that year or the full number of years.

Leading Varieties

Stoneville 7, Auburn 56, Empire, Plains, Dixie King and Stoneville 3202 are rather consistent among the highest producing varieties at most hill stations. Delfos 9169 has done well at State College and

STATE COLLEGE

Cotton Varieties, Central Station, State College, 1960

Variety	Yield per A., lbs. Seed cotton	Yield per A., lbs. Lint	Acre value, dollars, SLM	% picked first picking	Lint per cent	Fiber properties Staple 32nds inch	Fiber properties Strength 1,000 lbs. sq. inch	Fiber properties Fineness micronaire units
Delfos 9169	2363	853	303	52	36.1	36.0	88	4.6
Dixie King 45A	2089	813	281	71	38.9	34.3	87	4.7
Coker L H 61M	2091	805	279	62	38.5	34.3	93	4.8
Acala 4-42	1951	792	268	71	40.6	33.7	98	4.9
Coker L H 57-137	2047	788	273	63	38.5	34.0	91	5.1
Deltapine SL	1925	772	266	66	40.1	34.3	89	5.0
Stoneville 7	1897	772	261	68	40.7	33.7	91	5.3
Empire	1986	761	260	79	38.3	33.3	90	4.5
Dixie King	1980	756	262	72	38.2	34.3	92	4.7
Dixie King 3	1953	756	258	70	38.7	33.7	95	5.1
Coker 124C	1984	752	261	60	37.9	34.3	92	4.9
Rex	1941	751	260	81	38.7	34.0	86	4.3
DeKalb 108	1995	748	260	67	37.5	34.0	95	4.7
Coker 100A	1969	748	260	59	38.0	34.3	92	4.8
Plains	1958	746	255	67	38.1	33.0	92	4.7
Stoneville 3202	1871	741	252	71	39.6	33.0	86	4.8
DES 1030	1864	733	253	77	39.3	34.0	90	4.5
Auburn 56	1928	713	245	73	37.0	33.7	87	4.7
Fox 4	1814	700	239	70	38.6	33.7	89	5.5
All-In-One	1893	699	240	68	36.9	33.7	92	4.9
Lankart 57	1644	695	227	65	42.3	32.0	80	5.4
Stoneville 508	1701	686	236	72	40.3	34.7	89	4.5
Deltapine 15	1642	675	232	71	41.1	34.7	86	4.9
Pope	1590	630	208	73	39.6	32.7	95	4.4
Average	1921	747						
LSD 5%	155	61						
CV	7.1%							

Soil: Verona fine sandy loam.

Fertilizer: 400 lbs. 9-12-12 under plus 36 lbs N as a side dressing. Planted April 25. Poisoned 13 times.

Cotton Variety Averages, Central Station, State College

Variety	Yield per acre, pounds lint 1956	1957	1958	1959	1960	Average	Averages Dollar val. per a. SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Empire	666	604	358	735	761	625	222	36.7	34.1	150
Stoneville 7	658	522	348	799	772	620	219	38.6	34.2	190
Delfos 9169	565	488	352	777	853	607	222	35.8	35.7	172
Plains	644	536	409	702	746	607	215	37.1	33.9	171
Dixie King	601	582	403	688	756	606	216	37.3	34.4	153
Auburn 56	661	537	399	700	713	602	217	35.6	34.3	189
Stoneville 3202	595	544	405	684	741	594	208	38.6	33.5	188
Pope	664	545	465	605	630	582	204	39.2	33.5	178
Deltapine 15	553	520	412	612	675	555	197	39.6	34.5	185
Deltapine SL		608	441	635	772	------		------		
Stardel	648	551	331	696		------		------		
Rex	------	------	430	717	751	------		------		
Coker 100A	------	------	------	755	748	------		------		
Coker 124C				670	752					

Deltapine 15 at Raymond. Rex has done well the three years it has been in the tests and led the group in 1960 at Newton, on both soil types at Pontotoc and was second at Brooksville. Pope yields well particularly in North Mississippi but has weak stalks and often lodges badly; all stalks went down at State College in 1960.

HOLLY SPRINGS

Cotton varieties, North Mississippi Branch Station, Holly Springs, 1960

Variety	Yield per A., lbs. Seed cotton	Yield per A., lbs. Lint	Dollar val. per A. SLM	Lint %	Staple 32nds inch	Bolls per lb. Seed cotton	Bolls per lb. Lint	% picked first picking
Dixie King	2187	811	283	37.1	34.7	58	157	77
DeKalb 108	2170	803	282	37.0	35.7	66	179	73
Coker 124C	2159	790	280	36.6	36.0	72	197	69
Auburn 56	2112	779	272	36.9	34.7	69	188	74
Coker LH 61M	2098	778	273	37.1	35.0	66	177	70
Stoneville 7	1967	773	269	39.3	35.0	75	190	69
Coker 100A	2039	755	267	37.0	36.0	71	192	70
Delfos 9169	2074	747	266	36.0	36.7	64	178	64
Plains	2011	742	259	36.9	34.7	63	171	67
Rex	1990	742	259	37.3	34.3	69	184	64
Pope	1846	731	252	39.6	34.3	76	192	84
Deltapine SL	1832	713	249	38.9	35.0	79	203	74
Stoneville 3202	1836	711	246	38.7	34.3	73	189	80
All In One	2000	706	250	35.3	35.0	62	176	70
Fox 4	1927	694	245	36.0	35.3	75	210	71
Deltapine 15	1787	685	239	38.3	35.0	76	199	73
Empire	1841	668	234	36.3	34.7	58	161	65
DES 1030	1713	659	230	38.5	35.0	82	213	76
Stardel	1577	610	213	38.7	35.0	78	203	71
Average	1956	731						
LSD 5%	278	104						
CV		14.3%						

Soil type: Grenada silt loam. Fertilizer: 72-48-48. Planted over May 17. Poisoned 16 times.

Cotton Variety Averages, North Mississippi Branch Station, Holly Springs

Variety	Yield per acre, pounds lint 1956	1957	1958	1959	1960	Average	Averages Dollar val. per a. SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Stoneville 7	427	694	948	831	773	735	253	40.6	33.1	192
Pope	402	744	892	892	731	732	246	41.2	32.3	197
Auburn 56	384	707	828	853	779	710	251	37.5	33.6	199
Stoneville 3202	356	709	897	858	711	706	238	39.9	32.1	212
Dixie King	426	738	761	779	811	703	248	38.6	33.6	167
Plains	390	680	811	781	742	681	238	38.3	33.5	190
Stardel	373	758	856	711	610	662	233	39.6	33.6	215
Delfos 9169	369	701	743	707	747	653	234	37.3	34.6	191
Empire	393	720	727	699	668	641	226	38.7	33.5	171
Deltapine 15	333	632	831	717	685	640	222	40.7	33.5	199
Deltapine SL	------	715	849	771	713	------	------	------	------	------
Rex	------	------	657	756	742	------	------	------	------	------
Coker 124C	------	------	------	777	790	------	------	------	------	------
Coker 100A	------	------	------	784	755	------	------	------	------	------
Fox 4	------	------	------	831	694	------	------	------	------	------

DeKalb 108 is a synthetic hybrid. Auburn 56, Plains, Coker 100A, Empire, Dixie King, Rex, DeKalb 108 and All-In-One are resistant to wilt (Fusarium).

NEWTON

Cotton varieties, Coastal Plain Branch Station, Newton 1960

Variety	Yield per A., lbs. Seed cotton	Yield per A., lbs. Lint	Dollar val. per A. SLM	Lint %	Staple 32nds inch	Bolls per lb. Seed cotton	Bolls per lb. Lint
Rex	1432	590	194	41.2	32.0	67	162
DES 1030	1344	563	185	41.9	32.7	91	217
Stoneville 7	1333	560	183	42.0	32.0	78	187
Pope	1323	560	178	42.3	31.0	78	185
Dixie King	1355	549	181	40.5	32.3	61	150
Auburn 56	1363	545	175	40.0	31.3	75	188
DeKalb 108	1333	535	177	40.1	32.0	68	169
Deltapine 15	1219	519	165	42.6	31.3	81	190
Stoneville 3202	1240	516	165	41.6	31.0	81	195
Plains	1291	515	166	39.9	31.3	72	180
Coker LH 61M	1270	513	169	40.4	32.7	71	176
Delfos 9169	1280	502	171	39.2	33.3	67	170
Coker 100A	1262	502	170	39.8	33.0	76	191
Fox 4	1248	493	163	39.5	32.3	81	204
Deltapine SL	1171	492	161	42.0	32.3	86	206
Coker 124C	1217	490	162	40.3	32.7	76	189
All In One	1174	467	154	39.8	32.7	65	163
Empire	1089	446	147	41.0	32.3	57	140
Average	1208	494					
LSD 5%	161	66					
CV	11%						

Soil: Stough loam. Fertilizer: 90-72-72. Planted over May 18. Poisoned 12 times.

Cotton Variety Average, Coastal Plains Branch Station, Newton

Variety	Yield per acre, pounds lint 1956	1957	1958	1959	1960	Average	Averages Dollar val. per a. SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Auburn 56	383	508	270	623	545	466	162	37.0	33.3	201
Pope	397	540	250	537	560	457	155	40.5	32.4	198
Dixie King	400	487	220	589	549	449	156	38.2	33.4	166
Stoneville 7	389	461	180	590	560	436	151	39.3	33.2	208
Stoneville 3202	325	485	212	585	516	425	145	39.4	32.6	212
Plains	343	476	246	541	515	424	147	37.8	33.1	192
Empire	382	496	221	498	446	409	142	38.3	33.1	163
Delfos 9169	334	405	127	528	502	379	135	36.9	34.7	195
Deltapine 15	245	401	165	521	519	370	127	37.3	33.1	214
Deltapine SL	------	398	204	586	492	------	------	------	------	------
Stardel	310	440	190	571	------	------	------	------	------	------
Rex	------	------	295	589	590	------	------	------	------	------
Coker 100A	------	------	------	566	502	------	------	------	------	------
Coker 124C	------	------	------	572	490	------	------	------	------	------
Fox 4	------	------	------	543	493	------	------	------	------	------

PONTOTOC RIDGE

Cotton varieties, Pontotoc Ridge soil, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, 1960

Variety	Yield per A., lbs. Seed cotton	Yield per A., lbs. Lint	Dollar val. per A. SLM	Lint %	Staple 32nds inch	Bolls per lb. Seed cotton	Bolls per lb. Lint
Rex	1637	645	219	39.4	33.7	62	158
DES 1030	1574	636	215	40.4	33.3	86	214
Stoneville 3202	1500	603	204	40.2	33.3	73	181
Stoneville 7	1425	593	203	41.6	34.3	75	179
Pope	1437	576	195	40.1	33.3	77	191
Deltapine SL	1329	569	194	42.8	34.0	77	181
Auburn 56	1521	566	194	37.2	33.7	71	191
Deltapine 15	1360	557	188	41.0	33.7	77	189
Dixie King	1444	549	191	38.0	34.0	57	151
Fox 4	1413	547	189	38.7	34.0	74	191
Coker L H 61M	1388	543	188	39.1	34.0	70	179
Plains	1413	542	188	38.4	34.0	67	175
Coker 100A	1406	534	186	38.0	34.7	72	190
DeKalb 108	1363	530	181	38.9	33.3	64	163
Empire	1344	530	180	39.4	33.7	55	138
Stardel	1291	514	177	39.8	34.0	75	187
Coker 124C	1332	509	177	38.2	34.0	70	183
All-In-One	1363	508	174	37.3	33.3	65	174
Delfos 9169	1176	449	156	38.2	34.3	65	171
Average	1406	552					
LSD 5%	179	70					
CV	11.1%						

Soil: Atwood silty clay loam. Fertilized: 72-48-48. Planted April 27. Poisoned 6 times.

Cotton Variety Averages, Pontotoc Ridge Soil, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc

Variety	Yield per acre, pounds lint 1956	1957	1958	1959	1960	Average	Averages Dollar val. per a. SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Pope	401	546	734	854	576	623	206	39.8	33.1	179
Dixie King	330	615	707	892	549	618	210	37.4	34.3	152
Auburn 56	380	550	717	878	566	618	210	36.5	34.1	189
Stoneville 3202	277	551	737	798	603	593	199	39.0	33.3	188
Plains	355	531	749	743	542	584	207	37.2	34.0	175
Stoneville 7	310	486	676	662	593	545	194	39.1	34.1	191
Empire	287	543	657	707	530	545	194	37.5	34.3	150
Stardel	258	516	708	724	514	544	174	38.4	34.1	196
Deltapine 15	292	482	607	644	557	516	177	39.2	33.7	190
Delfos 9169	270	435	581	738	449	494	173	36.5	35.1	178
Deltapine SL	------	474	737	746	569	------		------		------
Rex	------	------	763	931	645	------		------		------
Coker 100A	------	------	------	946	534	------		------		------
Fox 4	------	------	------	751	547	------		------		------
Coker 124C				793	509					

FLATWOODS

Cotton varieties, Flatwood soil, Pontotoc Ridge-Flatwoods Branch Station, Pontotoc, 1960

Variety	Yield per A., lbs. Seed cotton	Yield per A., lbs. Lint	Dollar val. per A. SLM	Lint %	Staple 32nds inch	Bolls per lb. Seed cotton	Bolls per lb. Lint
Rex	1316	530	180	40.3	33.0	67	166
Dixie King	1297	505	172	38.9	33.0	58	150
DeKalb 108	1266	499	170	39.4	33.3	67	171
Deltapine SL	1207	495	163	41.0	32.7	84	204
Auburn 56	1291	491	163	38.0	32.7	77	203
DES 1030	1210	485	165	40.1	33.3	91	226
Coker 124C	1220	474	164	38.9	34.0	77	198
Coker 100A	1204	466	159	38.7	33.3	76	196
Stoneville 7	1117	465	157	41.6	33.7	80	191
Coker L H 61M	1164	462	159	39.7	34.0	73	183
Pope	1117	461	148	41.3	31.3	85	206
Fox 4	1189	458	152	38.5	32.3	80	209
Empire	1157	456	155	39.4	33.0	57	144
Stoneville 3202	1095	448	147	40.9	32.0	80	196
Plains	1132	441	146	38.9	32.7	71	184
All-In-One	1148	435	149	37.9	33.0	63	167
Delfos 9169	1080	408	143	37.8	35.3	68	179
Stardel	999	408	140	40.8	34.0	80	197
Deltapine 15	955	395	133	41.4	33.0	83	202
Average	1167	462					
LSD 5%	166	66					
CV	12.4%						

Soil: Faulkner fine sandy loam. Fertilizer: 72-48-48. Planted May 9. Poisoned 8 times.

Cotton Variety Averages, Flatwoods Soil, Pontotoc Ridge-Flatwoods Pontotoc Branch Station

Variety	Yield per acre, pounds lint						Averages			
	1954	1955	1956	1959	1960	Average	Dollar val. per a. SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Auburn 56	208	523	348	733	491	461	165	37.2	32.1	224
Empire	190	556	327	720	456	450	160	39.1	32.0	173
Plains	191	530	350	732	440	449	158	38.3	31.7	205
Delfos 9169	170	512	323	659	408	414	151	37.4	33.1	202
Deltapine 15	142	507	324	585	395	391	136	40.4	31.2	228
Dixie King	----	565	340	735	505	----		----		----
Stoneville 3202	----	512	332	694	448					----
Stoneville 7	----	----	319	707	465					
Pope	----	----	305	720	461					
Coker 124C	----	----	313	679	474					
Stardel	----	----	296	664	407					
Rex	----	----	----	710	530					
Deltapine SL	----	----	----	683	495					
Coker 100A	----	----	----	686	466					
Fox 4	----	----	----	660	458					

BROOKSVILLE

Cotton varieties, Black Belt Branch Station, Brooksville, 1960

Variety	Yield per A., lbs.		Dollar val. per A. SLM	Lint %	Staple 32nds inch	Bolls per lb.	
	Seed cotton	Lint				Seed cotton	Lint
Stoneville 7	1665	683	224	41.0	32.7	92	226
Rex	1704	675	223	39.6	32.7	76	192
DES 1030	1599	649	220	40.6	33.0	107	264
Coker 124C	1646	639	218	38.8	33.0	89	229
DeKalb 108	1646	631	215	38.3	33.7	78	203
Empire	1620	629	214	38.8	33.0	68	176
Coker 100A	1592	616	210	38.7	33.0	88	229
Coker LH 61M	1562	616	209	39.4	33.7	86	219
Delfos 9169	1695	615	215	36.3	34.3	79	218
Dixie King	1594	610	203	38.3	32.7	75	196
Pope	1460	610	195	41.8	31.3	97	233
Deltapine SL	1461	590	195	40.4	32.3	96	239
Fox 4	1527	590	196	38.6	32.7	90	233
Auburn 56	1539	582	194	37.8	32.7	89	235
Plains	1507	577	192	38.3	32.7	85	221
Stoneville 3202	1454	577	186	39.7	31.3	97	244
Deltapine 15	1400	564	191	40.3	33.3	92	227
All-In-One	1468	536	184	36.5	33.0	77	211
Stardel	1261	506	171	40.1	33.0	90	225
Average	1547	610					
LSD 5%	142	56					
CV	8%						

Soil: Houston clay. Fertilizer: 80-60-60. Planted April 11. Poisoned 7 times.

Cotton Variety Averages, Black Belt Branch Station, Brooksville

Variety	Yield per A, lbs. lint			Averages			
	1959	1960	Average	Dollar val. per a, SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Stoneville 7	827	683	755	257	39.7	34.0	215
Rex	784	675	729	248	39.0	34.2	185
Coker 124C	808	639	724	252	38.1	34.5	218
Dixie King	836	610	723	250	37.8	34.3	179
Plains	854	577	716	246	37.4	34.2	205
Empire	795	629	712	247	37.9	34.1	170
Stoneville 3202	845	577	711	239	39.2	32.6	227
Auburn 56	817	582	699	241	37.2	33.8	221
Deltapine SL	778	590	684	234	39.9	34.1	222
Coker 100A	717	616	666	231	38.1	34.3	214
Fox 4	728	590	659	226	37.7	34.0	225
Pope	705	610	658	219	40.3	33.0	218
Deltapine 15	750	564	657	226	39.9	34.5	215
Delfos 9169	693	615	654	234	35.6	35.6	210
Stardel	774	506	640	223	38.9	34.5	220

RAYMOND

Cotton varieties, Brown Loam Branch Station, Raymond 1960

Variety	Yield per A., lbs. Seed cotton	Yield per A., lbs. Lint	Dollar val. per A. SLM	Lint %	Staple 32nds inch	Bolls per lb. Seed cotton	Bolls per lb. Lint
Deltapine 15	1487	614	207	41.3	33.7	86	209
Stoneville 7	1548	607	206	39.2	33.3	85	218
Coker LH 61M	1559	603	209	38.7	34.0	76	196
Deltapine SL	1385	575	197	41.5	34.7	84	202
Dixie King	1394	541	184	38.8	33.7	64	166
DES 1030	1345	538	182	40.0	33.7	93	234
Stoneville 3202	1318	532	171	40.4	31.3	83	204
DeKalb 108	1339	517	176	38.6	33.0	72	187
Pope	1220	503	165	41.2	32.0	81	197
Coker 100A	1263	490	167	38.8	33.3	79	203
Plains	1266	489	167	38.6	33.0	77	200
Empire	1275	488	167	38.3	33.0	62	161
Coker 124C	1278	487	169	38.1	34.7	78	204
Rex	1255	484	161	38.6	32.3	75	196
Auburn 56	1260	474	162	37.6	33.3	76	202
Delfos 9169	1249	465	159	37.2	33.7	76	203
Fox 4	1162	449	153	38.6	33.7	86	222
All In One	1066	391	134	36.7	33.0	67	184
Average	1282	500					
LSD 5%	348	136					
CV	23.8%						

Soil: Richland. Fertilizer: 400 lbs. 12-12-12 under plus 100 lbs. ammonium nitrate around. Planted April 19. Poisoned 10 times.

Cotton Variety Averages, Brown Loam Branch Station, Raymond

Variety	Yield per acre, pounds lint 1955	1956	1957	1960	Average	Averages: Dollar val. per a. SLM	Lint percent	Staple 32nds. inch	Bolls per lb. lint
Auburn 56	759	497	983	474	678	247	35.2	33.8	208
Empire	702	550	864	488	651	233	37.4	33.5	158
Deltapine 15	816	403	735	614	642	230	38.6	33.7	204
Dixie King	714	552	735	541	635	226	37.0	33.4	160
Plains	781	502	694	489	616	219	36.8	33.0	194
Stoneville 3202	736	461	749	532	614	210	38.4	31.6	209
Delfos 9169	745	414	599	465	556	204	36.1	34.7	194
Pope	------	501	836	503	------	------	------	------	------
Stoneville 7	------	442	741	607	------	------	------	------	------
Deltapine SL	------	------	869	575	------	------	------	------	------

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Weed Control Handbook For Mississippi

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This publication is a result of cooperative work by all members of the State Weed Committee of Mississippi. This committee is composed of research and Extension personnel from the following agricultural agencies:

1. Agricultural Engineering Research and Crops Research Divisions, Agricultural Research Service, U. S. Department of Agriculture.
2. Mississippi Agricultural Experiment Station.
3. Mississippi Agricultural Extension Service.
4. Southern Forest Experiment Station, Forest Service, U. S. Department of Agriculture.
5. State Plant Board of Mississippi.

GLOSSARY
Nomenclature of Weeds

Common name	Scientific name
ash	Fraxinus spp.
barnyard grasses	Echinochloa spp.
Bermudagrass	Cynodon dactylon (L.) Pers.
bitterweed	Helenium tenuifolium Nutt.
boneset	Eupatorium perfoliatum L.
Brachiaria	Brachiaria spp.
chickweed (common)	Stellaria media (L.) Cyrill
cocklebur	Xanthium spp.
coffeeweed	Sesbania macrocarpa Muhl.
curley indigo	Aeschynomene virginica (L.) BSP.
crabgrass	Digitaria spp.
cypressweed (fennel, dog)	Eupatorium capillifolium (Lam.) Small
Dallisgrass	Paspalum dilatatum Poir.
dandelion	Taraxacum officinale Weber
dock	Rumex spp.
ducksalad	Heteranthera spp.
fleabane	Erigeron spp.
false mallow	Sphaeralcea spp.
wild garlic	Allium vineale L.
goatweed	Croton lindheimeri (Engelm & Gray) Wood
goldenrod	Solidago spp.
goosegrass	Elusine indica Gaertn.
henbit	Lamium amplexicaule L.
hickory	Carya spp.
horsenettle	Solanum carolinese L.
ironweed	Vernonia altissima Nutt
Johnsongrass	Sorghum halepense (L) Pers.
mayweed	Anthemis cotula L.
morningglory	Ipomea purpurea (L.) Roth.
nutsedge (nutgrass) or (coco)	Cyperus rotundus L.
persimmon	Diospyros virginianal L
pigweed	Amaranthus spp.
plantain	Plantago spp.
ragweed	Ambrosia spp.
red maple	Acer rubrum L.
redstem	Ammannia coccinea Rothb.
smartweed	Polygonum spp.
sneezeweed	Helenium spp.
spurweed	Soliva spp.
sumpweed	Iva ciliata Willd.
tarweed	Madia spp.
vetch	Vicia spp.
wild onion	Allium canadense L.
wild winter pea	Pisum sativum var. arvense L.

Nomenclature of Chemicals Used as Herbicides

This list of herbicides is intended only as an aid in obtaining the chemicals. Use of trade names does not imply endorsement of a product by the Mississippi Agricultural Experiment Station, and such names are given only for herbicides which, at the time of release of this bulletin, are marketed under the trade names listed only.

Common name	Trade name	Chemical name of active ingredient
AMA	Several Mfrs.	ammonium monomethylarsonate
amiben	---------------	3-amino2,5-Dichlorobenzoic acid
amitrole	Weedazol	3-amino-1,2,4-triazole
amitrole-T	Amitrole-T	3-amino-1,2,4-triazole-ammonium thiocynate
AMS	Ammate	ammonium sulfamate
atrazine	---------------	2-chloro--4-ethylamino-6-isopropylamino-s-triazine
BDM	DB Granular	borate-2,4-D mixtures
BMM	Ureabor	borate-monuron mixtures
CDEC	Vegedex	2-chlorallyl diethydithiocarbamate
CBM	Polybor Chlorate	chlorate-borate mixtures
CBMM	Chlorea 125	chlorate-borate-monuron mixtures
CIPC	Chloro IPC	isopropyl N-(3-chlorophenyl) carbamate
CMPF	Du Pont 685	1-chloro-N'-(3,4-dichlorophenyl)-N-N-dimethylformamadine
2,4-D	Several Mfrs.	2,4-dichlorophenoxyacetic acid
dalapon	Dowpon	2,2-dichloropropionic acid
DCMA	Dicryl	N-(3,4-dichlorophenyl) methylacrylamide
diuron	Karmex (Wettable Powder) Karmex DL (Liquid)	3-(3,4-dichlorophenyl)-1,1-dimethylurea
DNBP	Several Mfrs.	4,6-dinitro-o-se-butylphenol
DMA	Several Mfrs.	disodium monomethylarsonate
DMTT	Mylone	3,5-dimethyltetrahydro-1,3-5,2H-thiadiazine-2-thione
EPTC	Eptam	ethyl N,N-di-n-propylthiolcarbamate
ipazine	---------------	2-chloro-4-diethylamino-6-isopropylamino-s-triazine
MCPA	MCP	2-methyl-4-chlorophenoxyacetic acid
methyl bromide	Several Mfrs.	methyl bromide
MH	MH-30 & MH-40	1,2-dihydropyridazine-3,6-dione
monuron	Telvar	3-(p-chlorophenyl)-1,1-dimethylurea
NPA	Alanap 3	N-1-naphthylphthalamic acid
PCP	Several Mfrs.	pentachlorophenol
sesone	SES	sodium 2,4-dichlorophenoxyethyl sulfate
simazine	---------------	2-chloro-4,6-bis(ethylamino)-s-triazine
silvex	Several Mfrs.	2-(2,4,5-trichlorophenoxy) propionic acid
SMDC	VPM and Vapum	sodium-methyldithiocarbamate
sodium arsenite	Several Mfrs.	sodium arsenite
sodium chlorate + calcium chloride	Atlacide	sodium chlorate + calcium chloride
2,4,5-T	Several Mfrs.	2,4,5-trichlorophenoxyacetic acid
TCA	Sodium TCA	trichloroacetic acid
boric oxide	Borascu-44	boric oxide (anhydride)
boric oxide	Concentrated Borascu	boric oxide (anhydride)
-------------------	Garlon	2,2-dichloropropionic acid + 2-(2,4,5-trichlorophenoxy) propionic acid
4-(2,4-DB)	Several Mfrs.	4-(2,4-dicholorphenoxy) butyric acid

PRECAUTIONS

All agricultural chemicals should be handled with care. The manufacturer's label on the container includes precautions for safe handling which should always be observed. When material is spilled on the body, it should be washed off immediately. Not all of the materials are toxic, but most of them are irritating to the skin. In no case should the spray orifice tips be placed to the lips to blow out trash. Many of the materials are flammable and should be handled accordingly.

The Mississippi Legislature passed a law in 1952 regulating airplane application of 2,4-D, 2,4,5-T, and other hormone-type herbicides. Before aerial applications of such materials are made, operators should contact the State Plant Board, State College, Mississippi, relative to compliance with this law and the regulations promulgated thereunder.

Any equipment used for applying 2,4-D should not be employed for applying insecticides or herbicidal oils to cotton or other broadleaf crop plants. After each use, the spray tank, lines, nozzles, and pump should be drained and washed thoroughly with water containing a good household detergent. The tractor used in spraying 2,4-D should be thoroughly washed and steamed before use in growing cotton. Only the amine salts and low-volatile esters of 2,4-D should be used for weed control. Vapors arising from fields sprayed with volatile esters may cause serious injury to growing cotton and certain other plants.

If cotton is growing adjacent to fields being sprayed with 2,4-D or similar material, there is considerable risk of injuring the cotton seriously, particularly if wind is blowing toward the cotton. If calm periods are chosen for applying treatments of 2,4-D and low spray pressures are employed, it can be applied safely to fields adjacent to cotton. If corn is being treated, it may be advisable to leave a few rows of corn untreated next to the cotton to serve as a buffer against spray drift.

Year after year, farmers have been forced to spend much of their time and effort controlling weeds in crops, and yet yields and quality have been reduced in most of these years by weeds.

Until recent years, the only methods of controlling weeds were cultural and mechanical. During the last ten years, chemical control has been extensively studied. Rapid adoption of this practice gives ample proof that it has found a useful place wherever weeds are a problem.

Chemicals are not intended to replace sound management practices, but to supplement them. It should not be expected that a herbicide will in all ways be better than other means of weed control. It may be more effective, less expensive or require less labor, but will not necessarily have all these advantages.

The recommendations herein are based on the results of studies conducted by State and Federal research workers over several years and are believed to be safe and effective methods of weed control. Certain hazards and precautions are pointed out and an understanding of these common sense rules is necessary to derive full benefit from these recommendations.

Brush Control

It is often necessary to remove brush or undesirable trees from ditch banks, rights-of-way, woodlands, pastures, etc. When hand cutting or grubbing methods are used, this work not only is expensive, but usually must be repeated. Chemicals will normally reduce the cost of such an operation and may give much longer control.

Recommended Chemicals and Precautions

2,4,5-T and 2,4-D: These are commonly marketed as liquid concentrates, usually containing 4 pounds of acid equivalent per gallon. They are also marketed as special "brush killers" mixtures. They must be diluted for use. The dilutent will depend on the method of application and chemical. They are marketed either as an ester form or as an amine salt. These recommendations refer to ester form unless otherwise stated .

These chemicals are not corrosive and are not irritating when mixed with oil or water. They are hazardous to many plants and due care should be exercised in their use. Follow instructions on the label.

Methods of Application

Stump Application can be used at any time of the year, but the chemical should be applied immediately after the trees are cut. An oil solution of 2,4,5-T or a mixture of 2,4-D and 2,4,5-T should be used and the entire stump sprayed particularly the bark and exposed roots. Small knapsack sprayers using low pressure should be used to apply the chemical.

Frill Application is recommended for stems ranging from 3 inches in diameter up.

Frills are made by using an axe to cut overlapping notches in a continuous ring around the trunk of the tree. The nearer the base of the tree the cuts are made, the better. Cuts are made through the bark, but the chips are not removed. The **freshly cut** surfaces can be treated at any time of the year. Small knapsack sprayers operating on very low pressure can be used to apply the chemical. Frill treatments are more effective when applied in the spring when the trees are leafing out.

Girdling is related to frilling and em-

Table 1. Recommended applications and mixtures for various treatments.

Method of application	Season of year	Brush size[3]	Chemical	Carrier	Equipment	Type of treatment	Rate[1]	Mixture[1]/[2]	
								Gal. Chem.	Gal. carrier
Stump	All year	Any size	2,4,5-T ester	Diesel oil	Knapsack sprayer	Individual stem	Saturate stump	1	20
			2,4-D and 2,4,5-T ester	Diesel oil	Knapsack sprayer	″ ″	Saturate stump	1	20
Frills	All year	3″ dia. and larger	2,4,5-T ester	Diesel oil	Axe and Knapsack sprayer	″ ″	Completely fill frill	1	25
			2,4,5-T amine	Water	Axe and Knapsack sprayer	″ ″	Completely fill frill	1	25
Girdling	All year	From 3″-12″ DBH	2,4,5-T ester	Diesel oil	Axe or girdling machine	″ ″	Saturate girdle	1	25
		From 12″ dia. up	None	None	Axe or girdling machine	″ ″	None	None	None
Injection	All year	From 1″ dia. up	2,4,5-T ester	Diesel oil	Injector	″ ″	Fill each cup	1	9
			2,4-D and 2,4,5-T ester	Diesel oil	Injector	″ ″	Fill each cup	1	9
			2,4,5-T amine	Water	Injector	″ ″	Fill each cup	1	9
			2,4-D and 2,4,5-T amine	Water	Injector	″ ″	Fill each cup	1	9
Basal spray	All year	Under 2″ dia.	2,4,5-T ester	Diesel oil	Knapsack sprayer	″ ″	Wet to runoff lower 12″	1	20
			2,4-D and 2,4,5-T ester	Diesel oil	Knapsack sprayer	″ ″	Wet to runoff lower 12″	1	20
Foliage spray	Growing season	Up to 6′ in ht.	2,4,5-T ester	Water	Knapsack sprayer Boom jet Mist blower	″ ″	KNAPSACK—wet leaves, twigs well, use 1 gal. chem/100 gal. water.		
		Up to 15′ ht.	2,4,5-T ester	Water	Boom jet or mist blower	Broadcast	BOOM JET—40 to 50 gal/A. of 1 gal. chem/100 gal. water or 1 gal. chem., 5 gal. oil, 95 gal. water.		
			2,4,5-T ester	Oil-Water	Boom jet or mist	″			
		Up to 20′ ht.	2,4,5-T ester	Water	Mist blower	″	MIST BLOWER—5 gal/A. of ½ gal. chem. to 4½ gal. water or ½ gal. chem. to 4½ gal. oil or ½ gal. chem., ½ gal. oil, 4 gal. water.		
			2,4,5-T ester	Oil	Mist blower	″			
			2,4,5-T ester	Oil-Water	Mist blower	″			

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[1] The rates given here are for the easy to kill species. Where there is a predominence of hard to kill species as red maple, hickory, ash and persimmon these rates should be increased

[2] Mixture of 2,4,5-T and 2,4-D are based on commercial formulation of the low volatile esters containing 4 lbs. of 2,4-D or 2,4,5-T per gallon acid equivalent. [3] All diameters are 4½ feet above ground.

ploys the same chemicals and rates of application. Girdles are made either with an axe or a girdling machine. If axes are used, the girdle is placed at a height convenient for the axeman and as close to the base of the tree as possible. A double hack is made and the bark between removed completely around the tree. Only trees below 12 inches in diameter 4½ feet above the ground will require chemical. On trees that chemical is required it should be applied directly to the fresh cut with low pressure knapsack sprayers.

Tree Injection: Injectors generally consist of a hollow cylinder with a cut-off valve at one end and a chuck for inserting cutting bits in the other. Herbicide solution is carried in the hollow cylinder. The object is to place the herbicide in contact with living cells of the tree. Penetration of the bark is made by the cutting bit of the injector, not by the carrier.

This treatment is effective at any time of the year. Injections should be made as near the root collar as possible. Injecttions should be spaced not more than 1" apart between cuts (edge to edge). At least two injections should be made on smaller trees.

Either 2,4,5-T or 2,4-D plus 2,4,5-T as an ester or amine salt will give good results at the 40 pounds acid equivalent per 100 gallons of total solution. If the ester form is used, diesel oil should be used as a carrier. Water may be used as a carrier if the amine form is used.

Basal Spray: 2,4,5-T or a mixture of 2,4-D and 2,4,5-T in oil should be sprayed on bark completely around the lower 12" of the tree. The spray should be applied to wet the base of all stems until spray puddles on all sides and collects around the root collar at ground line. Good control can be obtained by saturating not more than 12 inches above the ground line. This treatment may be applied at any time of the year. This method of control should be limited to trees under 3 inches in diameter. Larger stems should be frilled.

Foliage Sprays: Foliage application can be used to control small sprout growth and understory hardwoods.

Complete coverage of foliage and stems with water or oil-water emulsions of 2,4,5-T ester at 4 pounds acid equivalent per 100 gallons of carrier is essential for good control of most hardwood species.

A boom jet sprayer mounted on crawler type tractors has given good control of understory with a minimum volume of 40 to 50 gallons per acre at the above concentration. A knapsack sprayer may be used when the brush does not exceed 6 feet in height. Any equipment giving complete coverage will give control.

It is possible to apply lower volumes of spray solution to forest understories with tractor-mounted or portable mist blowers capable of applying 2 to 5 gallons of spray mixture per acre on brush up to 20 feet in height. Two to four pounds of acid equivalent per acre will still be applied but in a much higher concentration.

All foliage applications must be applied during the growing season. Best results have been obtained by spraying in the early growing season, as soon as the plants have come into full leaf.

Persimmon has been controlled more satisfactorily with Silvex when applied at the same rate as 2,4,5-T described above.

AMS has been found to give good control of black willow where susceptible crops are too close for the use of 2,4,5-T. The rate and concentration of application is 60 lb. per 100 gallons of water sprayed to wet the foliage. Three to five ounces of spreader-sticker should be added to each 100 gallons of spray solution.

Corn

The weed problem in corn may be an early-season or a late-season one, or both. Crabgrass, Brachiaria, goosegrass, pigweed, and certain other small-seeded weeds usually constitute the early-season problem. Morning-glory and cocklebur may develop after the last cultivation causing lodging and lowered mechanical picker efficiency. Two kinds of treatments are recommended for the above problems.

Pre-Emergence Treatment

Where annual weeds present an early-season problem diuron, simazine, or atrazine is recommended. These materials are applied in the same manner as are herbicides recommended for pre-emergence treatments on cotton. Rates of application are presented in Table 2.

Pre-emergence use of diuron should be avoided when corn is planted under conditions not favorable for rapid germination and growth. Use of diuron under these conditions, which are most likely to occur on corn planted prior to April 10, can lead to serious corn injury. Regardless of the date of planting, corn seed should be planted a minimum of 1½ inches deep.

Experimental tests have shown that simazine or diuron gave control of Brachiaria where atrazine did not.

Atrazine applied as a post-emergence treatment at rates given for pre-emergence use has given excellent weed control with no injury to the corn. Make the application when weeds are small.

Post-Emergence Treatment

In cases where a weed problem develops, flame can be used alone or in conjunction with conventional sweeps with each cultivation. Timing of flaming treatment is especially important, since most effective control is obtained before weeds reach a height of three or four inches. In heavily infested areas frequent flame applications are essential for best results. The use of flame should be avoided during the time the corn is 2 to 12 inches high; it can be used before and after this time.

Flame cultivation with high-clearance rigs has appeared practical for late-season weed control in corn, since heavy growths of weeds often occur following late-season rains. High-clearance machines permit weed control to be extended beyond the normal lay-by date. Effective late-season control is an important factor in harvesting efficiency with mechanical pickers.

Broadleaf weeds such as ragweed, coffeeweed, cocklebur, and morning-glory may be controlled readily in corn with 2,4-D (an amine form). If the weeds occur before the corn is 12 inches tall an over-all broadcast spray may be made at the rate of 1/3 to 1/2 pound/A using 10 to 20 gallons of water. The over-all treatment, however, may cause some stalk brittleness, injure corn brace roots, and does not control grassy weeds that are up.

Where broadleaf weeds are present at and after lay-by, 2,4.D (an amine form) should be applied to give good coverage of the tops of the weeds. Two drop nozzles per middle can be employed to give good coverage of the weeds in the middles and the drill avoiding insofar as possible, spraying the corn leaves and stalks except for a few inches at the ground level. An application rate of ½ pound per acre on a broadcast basis is recommended. If only band treatments are necessary the amount of 2,4-D is reduced in proportion to the area actually sprayed.

The post-emergence treatments may be made on corn growing on any soil type. The cost of controlling tall growing broadleaf weeds in corn with 2,4-D is frequently more than offset by improved picker efficiency alone. Corn should not be treated with 2,4-D at the silking and tasselling stage but the directional spray can be applied safely at all other stages.

Where susceptible crops are growing near fields where 2,4-D is being applied, rigid precautions are necessary. It is suggested that nozzle orifices be of such size that pressures of less than 30 pounds can be used. It is advisable to cut off the sprayer before the end of the rows and cut it on only after the machine is several yards inside the field. Also it may be advisable to leave a few border rows untreated on each side of the field. Application should be made only when wind direction and velocity are favorable.

Table 2. Rates of diuron, simazine, and atrazine for pre-emergence weed control in corn.

Soil texture	Lb/A on 12-inch band[1]		
	Diuron	Simazine	Atrazine
Sandy soils	.0 to .0	0.6	0.6
Medium sandy loams	.11 to .16	0.6	0.6
Very fine sandy loams	.16 to .22	0.9	0.9
Silt loams	.22 to .30	1.2	1.2
Clay loams	.30 to .40	1.5	1.5
Heavy clay	.30 to .40	1.5	1.5

[1] Applies only where rows are 40 inches wide.

Cotton

The problem of improving weed control in cotton is complex. It is currently impossible to recommend a single practice that will work satisfactorily for all situations. The final authority on what method of weed control is used in a particular field is the farm operator. To make this decision he should be thoroughly familiar with his farm in relation to soil type, weeds present, available equipment, monetary resources, capability and capacity of labor resources, and with his own managerial ability.

In addition he should be familiar with the various methods of weed control in relation to cost, effectiveness, and limitations. He should clearly understand whether he wishes to reduce his labor requirements, reduce his cost of weed control or compromise on cost and labor reductions. **Further, if he decides to adopt new methods it may be necessary that he retrain his labor forces to perform the new operations.**

Pre-emergence herbicides, post-emergence oils, hand-hoeing, cross-cultivation, flame, lay-by herbicides, and spot-treatments can be combined with cultivation in many different ways according to the situation involved.

Selection of Method for Weed Control Practices Recommended: The data of Tables 3 and 4 are intended to serve as guides in selecting a practice or combination of practices for a number of common situations. **A thorough understanding of these data is essential to obtaining maximum benefits from the methods to be recommended.**

The fact that a particular practice is rated as "A" in Table 3 for a given problem does not necessarily mean that it is the best solution, but rather that it can be used effectively on that problem, either alone, or in combination with other effective practices. The data of Table 4 should be considered as relative, rather than absolute, estimates of costs.

In light weed infestations single practices and simple combinations are effective in reducing labor and costs. In heavy infestations more complex combinations are required. Making a combination too complex may reduce labor requirements, but can result in unnecessarily high costs.

Effects on Labor Requirements: Experiments have indicated that appropriate uses of the recommended chemical and mechanical weed control measures will reduce hoe-labor requirements by approxi-

Table 3. Relative values of various weed-control methods for specified situations.

	Soil texture and number of method[1]																				
	Sands							Sandy loam to friable clay loam							Heavy clays						
Major weed problem	1	2	3	4	5	6	7	1	2	3	4	5	6	7	1	2	3	4	5	6	7
Small seeded annuals[2]	F	A	A	A	F	B	F	A	A	A	A	F	B	C	D	D	D	A	F	A	D
Large seeded annuals[3]	F	D	A	D	-	A	F	F	D	A	D		A	F	F	F	D	D	-	A	F
Johnsongrass (spotted—up to 5%)	F	D	B	D	A	C	F	F	D	B	D	A	C	F	F	D	D	D	A	C	F
(light to moderate)	F	D	A	D	F	B	F	F	D	A	D	F	B	F	F	D	D	D	F	A	F
(heavy)	F	F	F	F	F	E	F	F	F	F	F	F	E	F	F	F	F	F	F	E	F
Nutgrass (spotted)	F	A	A	A		A	F	F	A	A	A	-	A	F	F	D	D	A	-	A	F
(light to moderate)	F	F	A	A	F	B	F	F	B	A	A	F	B	F	F	D	D	A	F	B	F
(heavy)	F	F	D	D	F	E	F	F	F	D	D	F	E	F	F	F	D	D	F	E	F
Perennial vines (spotted)	F	F	A	D	-	A	F	F	F	A	D	-	A	F	F	F	D	D	-	A	F
(light to moderate)	F	F	A	D	F	A	F	F	F	A	D	F	A	F	F	F	D	D	F	A	F
(heavy)	F	F	F	F	F	E	F	F	F	F	F	F	E	F	F	F	F	F	F	E	F

[1] 1 = pre-emergence herbicide.
2 = post-emergence oil
3 = cross-cultivation.
4 = flame.
5 = spot treatments.
6 = hand-hoeing.
7 = lay-by herbicide.

A = Excellent method.
B = Good method.
C = Fair method, frequently of value in special cases.
D = Fair method, occasionally of value in special cases.
E = Poor method, but may be the best available.
F = Not recommended.

[2] Crabgrass, brachiaria, goosegrass, pigweed, morningglory, etc., all in seedling stages or younger.

[3] Cocklebur, false mallow, etc.

Table 4. Relative costs of various herbicides and weed-control operations.

Herbicide and/or operation	Relative cost
Pre-emergence and its application[1]	\$2.95/A
Additional seed for cross-cultivation[1]	\$3.90/A
Hoe-labor[2]	\$0.43/hr.
Post-emergence oil, its application at 7 gal/A, plus cultivation	\$2.45/A/application
Post-emergence oil, its application at 5 gal/A, plus cultivation	\$1.95/A/application
Flame and cultivation	\$1.45/A/application
Flame without cultivation	\$1.25/A/application
Cultivation or cross-cultivation	\$0.50/A/application
Lay-by herbicide, and its application	\$4.80/A
Spot-treatment herbicide and its application	(Highly variable)

[1] Listed at 1.25 times cost/A/application to compensate for herbicide or seed lost when replanting is necessary.

[2] Includes charge for hauling and hoe-filing.

mately 50 to 80 percent on the average as compared with hand-hoeing.

Effects on Weed-Control Costs: In seasons of heavy weed infestations use of the recommended practices has resulted in savings up to approximately \$12 per acre while in light infestations the more complex practices have resulted in losses up to \$6 per acre.

Effects on Yields: Results to date indicate that the recommended use of herbicides, flame, and cross-plowing do not greatly affect yields. The prospective user of herbicides is cautioned that these studies are still in progress and that the only conclusion reached thus far in respect to yields is that the advantages of the practices recommended here substantially out-weigh the disadvantages and hazards.

Overall Evaluation: Judicious use of herbicides, flame, cultivation, and spot-hoeing as compared with hand-hoeing and cultivation, will permit the production of normal yields of cotton with substantially less labor at a stable and relatively low level of weed-control cost.

Land Preparation

A firm settled seedbed is important in obtaining a stand of cotton. Preparation of a good seedbed is equally important for obtaining best results with post-emergence chemicals and flaming that follow pre-emergence treatment. Fertilizers should be applied in such a way as not to lose moisture from the firm seedbed. The land should be bedded at least two to three weeks in advance of planting to increase the chances of adequate moisture for good germination of the seed. When the seedbed cannot be prepared early, it should be firmed with a cultipacker, drag or rollers.

There is no substitute for a good, uniform, well-drained seedbed for the best weed control program of any kind. There should be enough loose soil left on the seedbed after the beds have been raked or dragged off to adequately cover the seed. If the planter is equipped with runner wings, it may not be necessary to drag off the row. Uniformity in height and width of seedbeds is absolutely essential for post-emergence oils and flaming.

All fields should have adequate drainage for the operation of equipment.

Pre-Emergence Treatment

Equipment: Pre-emergence treatments may be made with equipment similar to that used in applying liquid insecticides. Most 1-, 2-, and 4-row planters can be modified to apply the pre-emergence herbicides correctly (see equipment section for details).

Planting: Following proper seedbed preparation, hill-drop the cotton seed 10 to 22 inches apart at a rate to give 4 to 7 stalks per hill. The number of seed to plant per hill will vary according to the germination percentage. Normally, 6 to 12 seed per hill will be required. If hill-dropping cannot be used then drill plant the cotton and thin at a later date.

Cross-plowing cotton for weed control has been practiced for a number of years in adapted situations. Chemical treatment can be used in combination with cross-plowing. The seed should be drilled at a high rate (60-90 lbs. per acre).

Where pre-emergence herbicides are to be used the cotton seed should be planted at least one-half inch deep and well covered with soil. Research results have shown no advantage in pre-emergence weed control obtained by using a wide roller instead of the regular planter press wheel. **However, if post-emergence treatments are to follow pre-emergence applications a wide flat press wheel will give a better shaped seedbed for the later operations and should be used.**

Placement of Herbicides: The chemical is sprayed on the soil behind the planter press wheel at or shortly after planting. The nozzle should be located to the rear of the planter press wheel or extra roller at the proper position to spray completely a 12-inch band centered on the drill.

Herbicides to Use: CIPC or diuron is recommended for use on sandy loam to clay loam soils for control of most small-seeded annual weeds. No pre-emergence herbicide is recommended for extremely sandy soils, for heavy clay soils such as Sharkey, Houston, etc., or for the control of perennial weeds.

Rates of Herbicides: Recommended rates for each herbicide are presented in Table 5. Within a given soil texture the lower side of the rate-range should be used on soils low in organic matter or general fertility. In fields consisting of more than one soil type the field should either be divided into smaller fields of the same type of soil; or if the area of the secondary soil type or types is insignificant in size, the rate should be selected in accordance with the major soil type.

Replanting: Adverse weather sometimes makes it necessary to replant cotton, including that which has received pre-emergence treatment. This failure to obtain or maintain proper stands after investing in a herbicide is an important limitation to the use of pre-emergence chemicals. **Retreatment with any known pre-emergence herbicide is not recommended.** Both research and experience have shown that retreatment may be applied without injury to cotton, but that the hazard of injury is greater than with a single application.

The farm operator contemplating retreatment is advised to consider the consequences he may face if the second planting also fails to emerge. In such an event he will have the problem of replanting in the presence of two herbicidal residues rather than one. The recommendation of the Mississippi Agricultural Experiment Station is that the cotton be planted without retreatment and that plans be made to protect the crop from weeds with a post-emergence herbicide or cross-cultivation.

If replanting is necessary and the row is free of weeds, replant in the previously treated band without further seedbed preparation. In cases where compactness of the soil makes this impractical, or the row is grassy, reprepare the soil and replant. This second preparation may be done in several ways, but the method used should be one that insures dilution of the herbicide by mixing with soil. The practice commonly known as "hipping-up" is an example of a method that does not dilute the herbicide concentration in the drill area, and therefore should not be used in soil preparation for replanting where a pre-emergence herbicide has been used. Where repreparation is necessary, no control of weeds by the chemical should be expected.

Duration of Effectiveness and Weeds Controlled: Under most conditions CIPC or diuron has given control of the troublesome annual weeds crabgrass, goosegrass, Brachiaria, and satisfactory control of

Table 5. Recommended rates and mixing data for pre-emergence herbicides in cotton where a 12-inch wide band is treated at the rate of 12 gallons per 13068 row feet.[1]

Herbicide	Lb. active ingredient per gallon	Soil texture	Rate-lb. active ingredient recommended for 13068 row-feet of 12-inch band[1]			Pints of chemical needed for 50 gallons of spray mixture where volume of spray application is 12 gallons per 13068 row-feet of 12-inch band[1] (Corresponds with rates presented at left)		
			Minimum	Intermediate	Maximum	Minimum	Intermediate	Maximum
			lb.	lb.	lb.	pints	pints	pints
CIPC	4.0	Medium sandy loam	1.2	1.4	1.8	10.0	12.0	15.0
CIPC	4.0	Very fine sandy loam	1.8	2.2	2.4	15.0	18.0	20.0
CIPC	4.0	Silt loam	2.1	2.4	3.7	17.5	20.0	22.5
CIPC	4.0	Clay loam	2.4	3.0	3.6	20.0	25.0	30.0
Diuron	2.8	Medium sandy loam	.14	.17	.20	1.68	2.00	2.40
Diuron	2.8	Very fine sandy loam	.20	.25	.28	2.40	3.00	3.35
Diuron	2.8	Silt loam	.28	.34	.37	3.35	4.00	4.43
Diuron	2.8	Clay loam	.37	.42	.50	4.43	5.00	5.99

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[1] 13068 row-feet = 1.05 acres if row width is 42 inches, 1.00 acre if width is 40 inches, 0.95 acre if width is 38 inches, and 0.90 acre if width is 36 inches. Calibrate sprayer to deliver 1 quart per nozzle in the same number of seconds it takes the sprayer to travel 272 feet. If this is done, row width can be ignored in calibration.

pigweed, morning-glory and certain other annuals. These materials do not control perennial weeds such as nutsedge, Johnsongrass, deep-rooted vines, etc. Pre-emergence treatment can usually be expected to control weeds in the treated band from 4 to 6 weeks. Weeds that escape pre-emergence control should be controlled by other methods before they develop beyond the seedling stage.

Post-Emergence Treatments

Weeds in the Middles: At the present it is recommended that weeds in the middles be controlled by cultivation, except after use of a lay-by herbicide.

Conventional Cultivation: This long-used practice needs little explanation. It consists of the use of sweeps to throw soil into the drill area for the purpose of smothering young weeds. It **should not be used** if the control of weeds by previous chemical or flame treatment is essentially complete, nor if the use of further post-emergence oil or immediate flaming is planned. If, however, neither oil nor flame can be used, and the control of weeds is not essentially complete, "dirting cultivation" **should be used.** Experiments have shown that "dirting cultivation," where properly used, is beneficial rather than detrimental to a chemical weed-control program. Failure to "dirt" or delaying "dirting" when it is needed is as detrimental to a successful program as is "dirting" when it is not needed. Care should be taken to avoid deep cultivation (which will prune the roots of the cotton), and even shallow cultivation should be used no more often than necessary for weed control.

Cross-Cultivation: Cross-cultivation is that practice where the cotton is drilled at a heavy rate and cultivated both with and at right angles to the row. This cross-cultivation thins the cotton mechanically and weeds a large part of what normally would be the drill area. It is recommended that its use be generally restricted to soils lighter than clays, and to relatively level fields where its use does not cause an erosion problem. Only good unbroken stands of cotton prior to cultivation are acceptable. The number of cotton plants left is determined by the width of the space between the sweeps, disk-hillers or other tools used in the cross-cultivation Final stands of 6 to 8 stalks per hill are satisfactory where cross-cultivation is at the standard row width (38-42 inch centers). Because second and later cross-cultivation will be likely to plow out additional plants, the first crossing should leave a few more plants than are needed for the final stand.

Cross-cultivation can be very effectively combined with pre- or post-emergence herbicides. Shield sweeps, disk-hillers, and other similar implements are recommended for the first crossing. If post-emergence oil is used it must be applied before the first cross-cultivation. As a general rule there will be time for only one oil application with cross-cultivation. Flame cultivation is an excellent tool to use in conjunction with cross-cultivation.

Herbicidal Oils: Only naphtha-type oils which have been proved satisfactory in field tests for selective weed control in cotton should be used. No fortifying agent should be present, and these recommendations are restricted to unfortified naphthas that are sold specifically for weed control in cotton after successful field trials.

In relatively level fields where herbicidal oils are to be used the seedbeds should be low and flat on top after planting. At least 16 inches centered over the drill should be level, smooth, free of clods, presswheel marks, and other obstructions. Normally two nozzles per row are used (see equipment section). One nozzle should be used on each side of the row and each nozzle should be 5 inches from the drill center. The two nozzles should be spaced and directed so as to prevent the two spray patterns from meeting head-on, as this might cause an objectionable deflection of the spray. Nozzles should be set so that the spray fan is horizontal and strikes the young cotton stem no higher than 1 inch from the ground level and gives adequate coverage of the weeds. The nozzles should be set so that they are 1 inch or less above the soil. A slight downward tilt may be given to the nozzles to increase the ease of keeping oil off the seed leaves of the cotton. If the downward tilt is excessive most of the oil will be undesirably concentrated on the ground at the base of the cotton stems and the band treated will be too narrow. The oil should settle in the 8- to 10-inch band centering on the drill.

In contoured fields (markedly sloping) it is more difficult to prepare proper seedbeds for use of herbicidal oils. In such cases a special setting of the equipment is described in the equipment section in connection with an oil applicator designed primarily for hill areas.

Although two nozzles per row can be used successfully, the use of an additional pair set to spray the shoulder of the row will increase the ease of the operation. The additional oil needed for these two nozzles will, however, double the cost of the oil. These nozzles should be set to spray parallel to the row and the pattern should extend slightly (2-2½ inches) into both the area to be cultivated and the area being sprayed by the other pair of nozzles.

The importance of keeping the oil on the lowest inch of the cotton stem cannot be over-stressed. Oil applied high on the stem, on the bud, or on the leaves will injure or kill young cotton plants.

When the cotton seedlings have been out of the soil for 7 to 10 days (at least 3 inches tall) the first application of herbicidal oil may be made, if needed. The first oil application will be needed when weeds make their first appearance in the treated drill area. If the cotton has been out of the soil for less than 3 weeks, from 5 to 7 gallons per acre of oil may be applied for the first application, depending on the amount of weed growth. Simplicity and efficiency of the first application of herbicidal oil can be greatly increased by making it prior to cultivation.

After the cotton has been out of the ground for 3 weeks, or after the first application, no more than 5 gallons per acre should be applied at any one time. These rates refer only to the oil sprayed into the drill area. If an additional set of nozzles is used to spray the shoulder of the row the amount of oil required per acre will be doubled. The oil sprayed into the drill strikes the cotton, and the rate of application is critical. Calibration of the drill-spraying nozzles should be exact. The oil from the shoulder spraying nozzles does not strike the cotton and, therefore, the rate is not critical.

Herbicidal oil is effective on small weeds only (less than 1 or 2 inches in height). It kills only those weeds which it contacts. Where a pre-emergence herbicide has been used there may be some tendency to delay the first application of herbicidal oil. This is a mistake except in the comparatively few cases where control by the pre-emergence herbicide is essentially perfect. The best overall results have been obtained by establishing 100 percent control of weeds as soon as possible after emergence of the cotton.

Repeat applications of oil as needed, except that they should be at least 5 days apart, and a total of no more than three applications should be made. Oil should not be applied after the bark begins to form or small bark cracks begin to appear at the base of the stem. Post-emergence oil should be applied only in healthy cotton. Do not apply post-emergence oil to cotton showing appreciable injury from pre-emergence herbicides, previous oilings, hail, disease or other factors.

By the time the second or third application of oil is made, many of the weed seed near enough to the soil surface will have germinated and have been killed. In the absence of excessive rain this may mean that no further weed control is needed in the cotton drill, provided no soil containing viable weed seed is thrown into the drill area during middle cultivation. Under such a circumstance, further weed control may consist of simply cultivating the middles while using a drill-protecting shield. If further weed control is needed in the drill area, it is recommended that flame cultivation be used for the remainder of the program.

Flaming: Flame cultivation has been used as terminal treatments following pre-emergence and post-emergence chemical treatments. Flame has also been used in conjunction with cross-plowed cotton to obtain substantial savings in weed control cost.

A flat type burner which uses butane, propane, or a mixture of the two is recommended. Mississippi Agricultural Experiment Station Bulletin 545 should be consulted for detailed information concerning flamers and the method of setting the burners.

As a general suggestion the grower should go to the field with the machine late in the afternoon or at night when the flame pattern will be visible. Visibility of the pattern will make accurate setting of the machine much easier. It is also a good idea to flame a few rows one day in advance of a general flaming. Appearance of the flamed cotton and weeds the next day may suggest changes needed to increase weed control or reduce damage to the cotton.

Flame treatments may be started when the cotton stems are at least 3/16 inch in diameter. The field should be free of large weeds when flaming is started because flame is much more effective on small succulent weeds than on a large well established one. After initiation, flame should be applied often enough to prevent weeds from growing beyond seedling stages. Should this prove impossible hand hoeing may be the most practical way to re-establish control, but even so the flamer may still be of value. Hand hoeing in such instances can be substantially reduced by a series of light fast flamings. Each of these flamings kills the tips of grass blades and sets afire the dry dead tip resulting from a previous flaming. Under such a system the amount of dead grass set afire is held to a minimum. If two heavy applications of flame were made the first would kill excessive weed growth and the second would set it afire. This flame from the weeds can cause heavy damage to the cotton.

Lay-by Treatment: The application of a lay-by herbicide for late-season weed control is recommended on a qualified and restricted basis. The recommendation must be qualified because the economic value of the practice has not been established. The recommendation must be restricted to situations in which late season weeds can be expected and in which the practice can be expected to be effective.

The effect of the practice of using a lay-by herbicide on the grade of hand or machine picked cotton has not been accurately evaluated in the Mid-South area.

Of several materials tested, diuron has been the most satisfactory when both cost and performance are considered. While the liquid formulation of this herbicide presents less of an application problem, the wettable powder performs just as well if properly applied and is considerably cheaper.

Results to date have indicated that a uniform stand of vigorous cotton, laid-by clean, and which laps well in the middles usually stays free of weeds until harvest without use of a lay-by herbicide. Weeds, including annual grasses, have developed into serious harvest problems where stands were broken, on the ends of rows, where cotton failed to lap in the middles, where the crop was still weedy after the last weed-control operation, and where certain lodging conditions permitted light to reach the soil in the row. In the latter situations the occurrence of excessive late-season rain tended to aggravate the weed problem while absence of excessive rain tended to prevent the development of a serious weed problem.

In experiments to date lay-by treatments of diuron as described here have had neither beneficial nor adverse effects on yield of cotton. Considerable leaf chlorosis of a temporary nature has developed in plots on the sandier soils, but this did not lower the yield. Nevertheless these results are interpreted as evidence against the advisability of using the practice on extremely sandy soils with low organic matter. It is unlikely that the treatment will result in yield increases except under conditions conducive to extreme weediness.

The use of diuron as a lay-by herbicide has proved effective in preventing or reducing the development of late-season annual weeds with the following restrictions:

1. The area treated must be free of emerged weeds at time of treatment.
2. The treatment should be applied before lower limbs of the cotton droop so that they interfere with the application.
3. Soil moisture after application must reach a high level by rainfall or irrigation within an estimated 10 days after application.
4. Good control without crop damage can be expected only on those soils and weed problems that respond well to the use of diuron pre-emergence.

If the farm operator decides to use this practice the following guides are offered:

Rates of application are shown in Table 6. Generally speaking these rates are an extension of pre-emergence rates for the same soils extended from band to broadcast treatment. The appropriate quantity of herbicide should be diluted with water. The degree of dilution should be such that the application will be made in a total volume of 20 to 40 gallons per acre. For example, if a rate of 1.00 lb./A of diuron in a total volume of 20 gal/A is used, the mixture would contain 5.0 lb. of diuron per 100 gallons of spray material. This same rate of herbicide in a total volume of 40 gal/A would mean that the mixture would contain 2.5 lb. of diuron per 100 gallons of spray material.

Table 6. Rates of diuron for lay-by treatment for various soils.

Soil texture	Lb/A of active ingredient (broadcast)
Coarse sandy loam, loamy sand, or sand	Do not treat
Medium sandy loam	.47 to .70
Very fine sandy loam	.70 to .93
Silt loam	.93 to 1.24
Clay loam	1.24 to 1.87
Clay	Do not treat

Lay-by diuron should be applied evenly to the soil surface of both the drill area and the middles (complete coverage). The spray pattern from one row should overlap the pattern from the adjacent rows from 1 to 2 inches in the center of the drill. Contact of the spray with the cotton should be at a minimum. The spray patterns, at the point of overlap, should be no higher than 1 or 2 inches above the top of the soil so that only the lower inch or so of the cotton plants is hit by the spray. See the equipment section for further details on methods of application.

Research to date has indicated that the spray is best applied just before the cotton becomes too large to cultivate (about the time the cotton laps in the middle). Practically, however, it is best to make the application just a little sooner than this so that the lower limbs of the cotton do not seriously interfere with application of the herbicide. It is suggested that the field be cultivated just before applying the herbicide (this can be done in the same operation with application), and that there be no emerged weeds in the field at the time of spraying. This weed-free condition may be obtained by any combination of a pre-emergence herbicide, post-emergence herbicide, hoeing, cultivation, and flame. Pending further research, it is suggested that the field should not be cultivated after the chemical is applied.

Spot Treatments

Spot-treatments are recommended for use in cotton where the weed infestation covers 5 percent or less of the drill area. Although this type of control is directed primarily towards control of Johnsongrass, it can be used on other weeds occurring as spot infestations. Prospective users of spot-treatments are cautioned that the economics have not been thoroughly evaluated.

See the section on specific weeds for detailed instructions.

Promising New Herbicides and Practices

Pre-Planting Herbicides: EPTC incorporated in the soil prior to planting has given good control of nutsedge and annual weeds with a high degree of cotton tolerance. EPTC is **not recommended** for either large or small scale trials.

Post-Emergence Herbicides: Ipazine in phytobland oil, DCMA in water, diuron in water, and CPMF in phytobland oil have all given promising experimental results as post-emergence herbicides in young cotton. As of December 12, 1960, DCMA is the only one of these that has been cleared for trial use under Public Law 518. None of the four are recommended for general farm usage. Additional comments with regard to trial use will be made when and if additional research or new clearances under Public Law 518 make such action advisable.

Parallel Flaming: Parallel setting of flame burners, as opposed to the currently recommended across-the-row setting, has given promising results for the control of weeds in relatively small cotton (4 inches tall). It is recommended that any usage of such a setting be restricted to a small acreage pending completion of additional research.

Horticultural Crops

Vegetables

These recommendations are set up to apply to commercial producers of these crops.

Because these crops are edible, one should be careful to **follow directions on the manufacturer's label.** Be sure to read the section on Handling and Mixing of Herbicides. If a weed control practice is desired in a given crop which is not included in this section, contact the county agent, or the local branch Experiment Station, or the State College station for the best recommendation for the area. The chemicals are recommended on active ingredient basis. All chemicals should be applied in a volume of 40 gallons of water per acre on a broadcast basis. Where band treatments are used the rate of water should be reduced in proportion to the area treated.

Transplants: Be sure the soil is firmed around the plants after transplanting. There should be no depression around the plants where the chemical might collect. If plants need watering, this should be done before the chemical is applied. Chemicals are more apt to damage tender plants than those which were allowed to harden.

Watermelons, Cantaloupes, Cucumbers: NPA is applied pre-emergence as a weed control measure in the above crops (Table 7). This chemical will give weed control from four to six weeks.

Table 7. Rates of NPA for watermelons, cantaloupes, cucumbers for various soil types.

Soil texture	NPA Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.4	1.4
Very fine sandy loams	0.7	2.4
Silt loams	1.0	3.4
Clay loams	1.6	5.4

[1] Applies only where rows are 40 inches wide.

Squash: NPA is also an effective chemical treatment of weed control in squash; however, lower rates are suggested because squash is less tolerant of NPA than cantaloupe, watermelon and cucumber. NPA should be applied as a pre-emergence treatment following seeding (Table 8).

Table 8. Rates of NPA for squash for various soil types.

Soil texture	NPA Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.3	0.9
Very fine sandy loams	0.3	1.0
Silt loams	0.5	1.6
Clay loams	1.1	3.6

[1] Applies only where rows are 40 inches wide.

Sweetpotatoes: A post-planting treatment, or the application of CIPC after the plant has set is an effective weed control measure in sweet potatoes. The chemical should be applied before annual grasses and certain other weed seed emerge. CIPC can be used only as a post-planting spray and should be effective for approximately four weeks (Table 9). If necessary, a second application can be made after the final cultivation. Precautions stated under "Transplants" in this section should be followed.

Table 9. Rates of CIPC for sweetpotatoes for various soil types.

Soil texture	CIPC Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.8	2.7
Fine sandy loams	1.0	3.3
Silt loams	1.1	3.6
Clay loams	1.3	4.5

[1] Applies only where rows are 40 inches wide.

Beans, Snap and Lima: For control of most broadleaved weeds and annual grasses in snap and lima beans, CDEC is applied as a pre-emergence treatment (Table 10).

Southern Peas: CIPC will give excellent control of most broadleaved weeds and annual grasses in southern peas. The chemical is applied as a pre-emergence treatment immediately after planting. (Table 11).

Table 10. Rates of CDEC for beans, snap and lima, for various soil types.

Soil texture	CDEC Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.6	2.0
Very fine sandy loams	0.9	3.0
Silt loams	1.2	4.0
Clay loams	1.8	6.0

[1] Applies only where rows are 40 inches wide.

Table 11. Rates of CIPC for Southern peas for various soil types.

Soil texture	CIPC Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.6	2.0
Very fine sandy loams	0.9	3.0
Silt loams	1.2	4.0
Clay loams	1.8	6.0

[1] Applies only where rows are 40 inches wide.

Sweet Corn: The corn should be planted from 1½ to 2 inches deep in a firm seedbed. When simazine is used as a weed control measure in sweet corn, **do not** plant the treated fields to another crop during the same growing season (Table 12). CDEC may be used for weed control in sweet corn at the same

Table 12. Rates of simazine for sweet corn for various soil types.

Soil texture	Simazine Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.3	1.0
Very fine sandy loams	0.6	1.9
Silt loams	0.9	2.9
Clay loams	1.3	4.0

[1] Applies only where rows are 40 inches wide.

rates given for beans, lima and snap (Table 10).

Strawberries

Annual Program: Ten to 15 days before transplanting, sesone may be applied on beds to give a weed-free bed at transplanting time; or if this practice is not needed, sesone is applied as a posttransplanting treatment on weed-free beds (Table 13). This treatment may be made following transplanting and at monthly intervals until 7 days of picking.

Table 13. Rates of sesone for strawberries for various soil types.

Soil texture	Sesone Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.3	1.0
Very fine sandy loams	0.6	2.0
Silt loams	0.9	3.0
Clay loams	1.0	3.6

[1]Applies only where rows are 40 inches wide.

Matted Row Program: The chemical control measures stated above for the annual program may be used initially for this program. For winter weed control, however, CIPC may be used as a post-emergence application on established strawberry plants which are dormant. The chemical should be applied as a preemergence treatment to the weeds (Table 14).

Table 14. Rates of CIPC for strawberries for various soil types.

Soil texture	CIPC Lb/A 12-in. band[1]	 Lb/A broadcast
Medium sandy loams	0.5	1.8
Very fine sandy loams	0.7	2.4
Silt loams	0.8	2.7
Clay loams	0.9	3.0

[1]Applies only where rows are 40 inches wide.

Broadleaf weeds such as dock may be controlled by spot treating with an amine form of 2,4-D. This treatment is made during the dormant season before blossoming and after picking, but before runners form. See section, Weed Control in Established Lawn and Turf—Broadleaf. Weeds for instruction for mixing the 2,4-D.

Lawns and Turf

Proper lawn establishment and maintenance is the best form of weed control. When the lawn is established be sure to use adapted varieties, proper seeding or sprigging rates, and water to insure fast germination and coverage. After the new lawn is established, or on an old lawn, always mow properly, fertilize adequately, irrigate as needed, and control insect and disease problems. When any part of a proper management program is left out or performed improperly the grass of the lawn becomes weak, the stand is decreased and weeds invade.

New Lawn or Turf Establishment

Establishment of a new lawn or seedbeds or rebuilding of areas of an old one may be facilitated by preseeding treatments. These chemicals kill weed seed, rhizomes and bulbs and then decompose in the soil, allowing planting of the lawn at a later date. All of these chemicals will kill growing plants and should not be applied where they may contact the roots of valuable plants. It is recommended that test plantings be made before planting the entire lawn in order to determine whether all of the chemical has left the soil. The time required for breakdown in the soil depends primarily on temperature. Chemicals and rates recommended for preseeding treatment in lawns are:

Methyl bromide: It may be used as described under Specific Weeds—Nutsedge. Wait 4 days before seeding and 2 days before sprigging in the treated area.

DMTT: Apply 7.5 pounds per 1,000 square feet. Apply dry and mix well into the top six inches of soil. Apply two inches of water to the treated area. After about two weeks, break the soil to allow the gaseous products of the chemical to escape and make a test planting two days later.

SMDC: Apply 12.5 quarts per 1,000 square feet. The chemical is handled in the same way as the above, except that it is a liquid and is applied by mixing with water in a sprinkler can or with a hose-attached sprayer.

For control of nutsedge in areas where methyl bromide is not used, Amitrole may be used. This chemical may be mixed by placing 3 level tablespoons in one gallon of water. Spray the shoots until thoroughly wet when they are at 4 to 5 inches tall and growing vigorously. This treatment may be applied either broadcast or as a spot treatment. Where practical, cultivate treated areas when plants become white. Retreat when dormant nuts germinate. This treatment may only be applied in areas where food crops are not to be planted following treatment.

Dalapon at ¼ pound in 1 gallon of water plus 1 teaspoon of liquid or 1 tablespoon of a dry household detergent applied until wet to Dallisgrass and other seedling grasses is effective. Following kill of the grass, the soil may be spaded or turned and left for 2 to 3 weeks before seeding or sprigging the lawn grass.

Weed Control in Established Lawn and Turf

Before any chemicals are applied have the lawn in a vigorous state of growth. This can be accomplished by watering and fertilizing. This will insure rapid coverage by the established grass after the weeds are killed.

Broadleaf Weeds: To control dandelion, plantain, dock, spur weed, and other common broadleaf pests apply 2 tablespoons of 2,4-D amine in 1 to 5 gallons of water broadcast per 1,000 square feet. This treatment may be applied in lawns of the Bermudagrass and Zoysia. The treatment should be applied in spring or fall when weeds and turf are actively growing.

The winter weeds, henbit and common chickweed, may be controlled satisfactorily by treating with a spray of DNBP. Treatments should be made when the temperature is above 60° F, using 3 level tablespoons in 1 to 5 gallons of water and apply broadcast to 1,000 square feet. The spray should not come into contact with the foliage of desirable ornamental plants.

Clovers: The clovers, white, hop, bur, and others may be removed from Bermudagrass lawns with a solution of 2 tablespoons of 2,4,5-T amine in 1 to 5 gallons of water applied broadcast to 1,000 square feet. If broadleaf weeds as mentioned above and clovers are present two tablespoons each of 2,4-D and 2,4,5-T may be mixed together in 1 to 5 gallons of water and sprayed broadcast in one treatment. Avoid spraying when the wind is high or near susceptible ornamentals to prevent spray drift. If treatment cannot be made because of nearby ornamentals or garden plants or if only spot treatment is desired, the herbicidal solution may be applied with a sponge fastened to a stick and touched to the weeds or with a clothes sprinkler or with a broom dipped into a bucket of solution. Hose-attached sprayers should not be used for the application of 2,4-D or 2,4,5-T.

Crabgrass: For post-emergence control in Bermudagrass and Zoysia lawns use DMA or AMA at a rate stated on the manufacturer's label. A household detergent at the rate of 1 teaspoon of the liquid or 1 tablespoon of the dry form should be added to each gallon of the spray mixture. Repeat at two week intervals as needed. CAUTION: These materials are organic salts of arsenic, which is extremely poisonous. The material of the mixture must not be within reach of children or animals and prolonged contact must be avoided by the user.

Dallisgrass: For heavy infestations of Dallisgrass in Bermudagrass and Zoysia lawns control may be obtained with broadcast treatments of DMA and AMA at rates stated on the manufacturer's label. Use the rate of DMA or AMA recommended for "mature crabgrass." Use the detergent with these chemicals at the rate given above for crabgrass.

Spot spraying of Dallisgrass in any turf may be done with DMA or AMA mixed as mentioned above and applied to the grass until wet. High concentrations of these chemicals will injure or kill the lawn grasses near the Dallisgrass.

Goosegrass - Crowfoot: Follow the same control as stated under Dallisgrass.

Bermuda, Zoysia, St. Augustine, and Centipede Grasses: These grasses that grow over driveways or walks or into flower beds and gardens may be kept under control by periodically spraying the borders or edges with an herbicidal oil. Very low pressure should be employed to avoid any misting of the oil which may drift onto flowers or vegetables and damage them.

Nutsedge: Where nutsedge is a problem in established lawns it may be partially controlled by repeated applications of DMA or AMA. These chemicals may be mixed and applied as described under Dallisgrass.

Wild Onion: Refer to Specific Weeds —Wild Onion and use the recommendation for control of wild onion in pastures or small grains where infestation is heavy. Mix 2 tablespoons of the 2,4-D ester in 1 to 5 gallons of water and apply broadcast to 1,000 square feet. Spot treatment of wild onion with MH in lawns only is an effective control measure. Mix 1 pint of the MH with 2 gallons of water and add either 1 tablespoon of dry or 1 teaspoon of liquid detergent. Thoroughly wet the shoots of the onion with the spray.

Permanent Pastures

Several factors enter into the problem of weeds in pastures and need to be considered in a weed control program.

A good stand of pasture grasses and legumes—a good sod—helps in preventing weed encroachment and growth. High fertility, reseeding if necessary, and good grazing management (do not overgraze) help in development and maintenance of a good sod and help in control of weeds.

Mowing sometimes gives fair control of some weeds but usually is not completely satisfactory. Many weeds are poorly controlled and often mowing may result in a decrease in forage production.

Spraying with 2,4-D will control a majority of the vast number of weeds that occur in pastures and if done right and timed properly should result in increased forage production. Use an amine form of 2,4-D since it is not as volatile as the esters.

Use 2/3 to 1 lb. of 2,4-D in 10 to 20 gallons of water per acre as a broadcast application. Spray as soon as possible after most of the weeds are up and growing and before droughty summer weather if possible.

Some weeds require a higher rate of 2,4-D. Some of these are mayweed or dog fennel, ironweed, cypress weed, horsenettle, fleabane, goldenrod, smartweed, and wild onion. Two lbs. of 2,4-D per acre should be used on these.

Some weeds also may require more than one spraying, such as horsenettle and wild onions. For horsenettle, a repeat treatment the same summer and also repeated annually for 3 or 4 years may be needed. For wild onions and garlic a late fall and early spring treatment repeated annually for 2 to 4 years may be needed. The ester form of 2,4-D is more effective on the onions and garlic.

Some weeds require a higher rate of 2,4-D as they get older, such as bitterweed. After flowering starts use 1½ to 2 lbs. per acre on bitterweed.

Late fall treatment may be the best time to control some winter-growing weeds such as dock and thistles. Sometimes dock may also require an early spring treatment for complete control.

Pasture grasses and legumes should be well established and the weeds emerged but still small when treatment is made. It is hazardous to treat seedling grasses or legumes. Treatments should not be made during long droughty periods because stunted or slowly growing weeds are somewhat resistant to the 2,4-D spray, and higher rates will need to be used.

Permanent pastures heavily infested with bitterweed and near cotton fields can be safely sprayed in February, March, or April before the cotton comes up. Apply 1 lb. of 2,4-D per acre in 10-20 gallons of water as a broadcast pre-emergence treatment for the control of bitterweed.

Bermudagrass, Dallisgrass, fescue, Bahia, Coastal Bermuda, Johnsongrass, white clover, lespedeza, and black medic are not injured to any significant extent by the treatment. Plant growth may be retarded for a short period in these plants but they quickly recover. Pasture species severely injured or killed by 2,4-D are crimson clover, vetch, wild winter peas, and hop clover.

Excellent control of most broadleaf weeds such as bitterweed, tarweed, croton, cocklebur, sumpweed, ragweed, boneset, and sneezeweed can be expected.

4-(2,4-DB) is less injurious to most legumes than 2,4-D and is effective against dock, croton or goatweed, and bitterweed at 2 lbs. per acre. It is also more expensive than 2,4-D. Use only on crops grown for seed, since 4-(2,4-DB) has not been cleared for use on crops for forage.

Observe all precautions on the label of the 2,4-D container and exercise extreme care to prevent drift of spray to growing cotton and other susceptible crops or ornamental plants.

Rice

Broadleaf Weeds

Coffee-weed, curly indigo, ducksalad, and redstem present the main broadleaf weed problem in rice. These weeds can be controlled in rice fields with 2,4-D, 2,4,5-T, and Silvex. Coffee-weed and redstem are controlled equally well with either of the three herbicides; however, 2,4,5-T is the best one for control of curly indigo. Ducksalad is best controlled with 2,4-D.

These herbicides should not be applied when it is windy nor when a breeze is blowing toward a nearby field of cotton or other sensitive crop. Soybean, sweetpotato, and many of the common vegetables are sensitive but cotton is particularly sensitive to these herbicides. Field research over a period of several years has indicated that 2,4,5-T (amine form) is not as toxic to cotton as 2,4-D at equivalent rates. This should not be taken to mean that these herbicides will not injure cotton, but rather that injury to cotton from drift of 2,4,5-T is usually not as severe as that caused by 2,4-D.

Certain esters of these chemicals are volatile and vapors will move for great distances. Several commercial concerns formulate low volatile esters which will give the desired weed control with a low

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[1] The cooperation of Dr. R. J. Smith, Jr., Agronomist, Crops Protection Research Branch, ARS, USDA, Stuttgart, Arkansas, in preparing the Rice Section is gratefully acknowledged.

vapor hazard. Because of the risk involved in using the volatile esters of these chemicals, the following recommendations apply only to spray applications of the amine and low volatile ester formulations.

Time to Spray: Rice seedlings are very sensitive to 2,4-D and similar herbicides. A substantial reduction in yield may occur if herbicides are applied before rice is 7 to 9 weeks old (after emergence) or by treating at or after the boot stage. A slight reduction in yield may result from treatment during the jointing stage. If the weed infestation demands an early application, 2,4,5-T amine may be used as early as five weeks after emergence of the rice. Application of 2,4-D should not be made before the rice is seven weeks old. The least injury (best time to treat) to rice from herbicide treatment is during the late tillering stage (7 to 9 weeks after emergence).

Rates of Chemicals: Apply 2,4-D or 2,4,5-T at the rate of 3/4 to 1½ pounds (acid equivalent) per acre in 5 to 10 gallons of water if ground equipment is being used. However, 3 to 5 gallons of water has been adequate where aircraft was used. In the event of heavy weed infestation, early application (5 weeks after seedling emergence) of 2,4,5-T amine at the rate of ½ to 3/4 pound per acre can be used.

Apply silvex at the rate of 1 to 1½ pounds (acid equivalent) per acre in the same volume of water suggested above for 2,4-D. A 3/4 pound rate may be used five weeks after emergence if necessary, but the high rate should be used in later applications.

The addition of a wetting agent to the chemical solution will increase the effectiveness of these chemicals. Good results have been obtained by using household detergents at a rate of one tablespoonful per 10 gallons of spray.

Grasses

Barnyard grass (millet, water grass, or bluestem) is one of the most serious weeds in rice. CIPC at 8 pounds per acre (2 gallons of 4 pounds per gallon emulsifiable concentrate) using a minimum of 10 gallons per acre of total spray can be used effectively in controlling barnyard grass in rice. Use water as the carrier and apply as a broadcast spray using either ground or airplane equipment. When applying CIPC by airplane use droplet size and swath width that will permit the spray to be deposited uniformly onto the soil surface. If spray volume is low, droplet size is small, and width of swath is wide; much of the spray may drift into the air.

The rice should be drilled one to two inches deep to reduce possible injury from the chemical. Rice may be broadcast-seeded if the seeding rate is increased and the seed are incorporated uniformly within the surface 2 inches of soil. Rice seed located in the surface ½ to 1 inch of soil may be injured severely by CIPC. Seeding rice one to two inches deep protects it from CIPC since the herbicide is located in the surface layer of soil and the rice roots are located below the herbicide zone. Since seedling grass roots are located in the herbicide zone, the grass is killed by CIPC. Rice seedlings have very little tolerance to CIPC when roots contact the herbicide. CIPC cannot be use safely on water-seeded rice.

Apply CIPC just as soon as grass begins to emerge but before it is beyond the first-leaf stage of growth (¼ to ½ inch high). Rice may range from pre-emergence to emergence at this time. If soil moisture and temperature are optimum the grass will generally be in the first leaf stage of growth 4 to 8 days after seeding rice. If applied too late, CIPC will not control barnyard grass satisfactorly.

The soil moisture must be adequate after spraying for satisfactory control of barnyard grass. This may be obtained either by rainfall or by irrigation before rain does not occur at the proper time and if the soil becomes dry to the point of crusting within two to four days after treatment with CIPC, flush the field. Flood rice at the normal time — usually 10 to 14 days after CIPC treatment. CIPC disappears from the soil within 2 to 3 weeks after application. Consequently, the flood should not be delayed much beyond the above date or a new crop of grass may emerge.

Small Grains

Dock and other weeds may be controlled with 2,4-D in the early spring. Dock is most sensitive to 2,4-D when it is growing actively. During periods of retarded growth or as the plant nears maturity, the compound does not give adequate control. Because the herbicide is most effective during warm, sunny weather, application should be made during such a period. The time for spring application is when the dock resumes growth but prior to development of the stalks and seed heads.

Application of 2,4-D to dock in small grains should be made after the crop plants are well tillered but before the cereal stems have elongated. In most seasons the period from February 1 to March 15 could be considered a safe time to treat cereals with 2,4-D for dock control.

The amine form of 2,4-D should be applied at the rate of 3/4 to 1 pound active material per acre. Ten to 20 gallons of water containing the 2,4-D will spray one acre satisfactorily with ground equipment. Good success has been obtained also from aerial applications at lower volumes.

One application of 2,4-D made properly will give a high percentage control of dock. Because there are numerous dormant seeds in the soil more than one year is required to eradicate dock from infested areas. Applications of the amine form of 2,4-D to control dock causes little damage to established stands of white and Ladino clovers. The clovers show curling and some stunting following treatment but can be expected to recover by the end of the growing season. Pasture grasses are quite tolerant to this form of 2,4-D. Severe damage, however, can be expected when this amount of 2,4-D is used on young legume and grass seedlings.

Wild winter peas and vetch in small grains can be controlled with the same rate of 2,4-D as used for dock, but better control of these two weeds can be obtained with 2,4,5-T at the rate of 3/4 to 1 pound (acid equivalent) per acre. This chemical is more expensive than 2,4-D and will not control dock as well as 2,4-D and is also more injurious to desirable legumes.

When weed control treatment is combined with the application of liquid nitrogen fertilizer, the rate of 2,4-D should be reduced to ½ pound per acre. Low volatile ester formulations of 2,4-D can be mixed directly with the liquid nitrogen. Amine formulations can be used if first diluted with water in the proportion of one part of the 2,4-D formulation to 3 to 5 parts of water.

Soil Sterilization and General Contact Weed Control

Soil sterilization as used in this bulletin means the control of all plants in an area by the use of chemicals. Bacteria, fungi, insects, nematodes, etc., may or may not be killed. In soil sterilization, roots and rhizomes of weeds as well as leaves and stems are killed thereby preventing regrowth. Reinfestation occurs by germination of weed seeds that are not killed and by movement of weed seeds and various plant parts into the treated area after the herbicide residue dissipates.

Soil sterilization can be temporary or semi-permanent depending on the kind and rate of chemical used. Choice of chemicals should be made on the basis of length of sterilization desired as well as cost and nature of weed problem.

Herbicides useful for soil sterilization are given in Table 15. Applications for the control of perennial weeds have given best results in the fall, whereas annual weeds are more easily controlled by treatments made in the spring. If excessive vegetation is present, the area should be clipped as close as possible and the refuse removed in order to ensure good coverage of the soil. Soil type, rainfall and other factors influence the ef-

Table 15. Herbicides for use in soil sterilization.

Herbicide[1]	Active ingredient	Lb. formulation per 100 sq. ft.	Lb. formulation per acre	Vegetation	Approx. duration
Boric oxide	B_2O_3 44%	7 to 11	3000 to 4800	Annuals and most shallow rooted perennials	1 yr.
Boric oxide	B_2O_3 61.5%	5 to 9	2200 to 3900	Same as above	1 yr.
BDM	Sodium borates-90.5% 2,4-D-7.5%	1 to 3	435 to 1300	Broad-leafed annuals and shallow rooted perennials. Not recommended for grasses	1 yr.
CBM	B_2O_3 49% $NaClO_3$ 25%	2 to 4	870 to 1740	Same as above	1 yr.
CBMM	$NaClO_3$ 40% Sodium metaborate 55% Monuron 2.4%	2 to 4	1300 to 1750	Annuals and most shallow and deep-rooted perennials	1 to 2 yr.
Monuron	3-(p-chlorophenyl) 1,1-dimethylurea 80%	1/10 to 2/10	40 to 80	Same as above	2 to 3 yr.
Sodium Chlorate	$NaClO_3$ 99%	1½ to 2	650 to 870	Same as above	1 yr.
TCA	Na trichloro-acetate 90%	2 to 4	870 to 1740	Same as above	1 yr.
BMM	Sodium borates 94% Monuron - 4%	1 to 2	435 to 870	Same as above	1 yr.
Methyl Bromide[2]	Methyl bromide	1	440	Annuals and most shallow and deep-rooted perennials	24 to 72 hr. (temporary)
SMDC	SMDC	1 and 1/8	490	Same as above	14 to 21 days (temporary)
DMTT	DMTT	3/4	300	Same as above	14 to 21 days (temporary)

[1] The active ingredient of these herbicides may be available under different trade names. The active ingredient applied should approximate those given in the table.

[2] Must be applied under a gas-proof cover. See section on **Specific Weeds, Nutsedge** for application details and precautions.

fectiveness of the chemicals. When vegetation begins to reappear on the treated areas, another application is needed. Retreatments made at ¼ to ½ the original dosage are generally adequate to maintain the area free of weeds.

Table 16. Herbicides for general contact weed control.

Vegetation	Herbicides[1] and additives	Amt. of herbicides, additives, and carriers to mix	Spray volumes and other comments	Number of applications for seasonal control
Annual weeds	Herbicidal oil	Undiluted	50 to 100 gal. per acre	6 to 10
	Herbicidal oil plus PCP or DNBP	25 to 50 gal. of oil, 1 pt. of PCP or DNBP, and 50 gal. water	Agitation necessary. Spray to wet foliage	5 to 9
	Diesel oil plus PCP or DNBP	30 to 60 gal. of oil, 2 pt. of PCP or DNBP, and 50 gal. water	Agitation necessary. Spray to wet foliage	5 to 9
	Amitrole-T plus wetting agent	4-6 lbs. amitrole-T, 6 fl. oz. of wetting agent, and 100 gal. water	Spray to wet foliage	4 to 8
	Garlon	3 gal. of Garlon in 100 gal. of water	200 to 300 gal. per acre	1 to 3
	2,4-D amine plus dalapon plus wetting agent	2 lb. acid equivalent 2,4-D, 4 lb. dalapon, 6 fl. oz. of wetting agent, and 100 gal. water	100 gal. per acre or spray to wet foliage	2 to 4
	Amitrole-T plus monuron or simazine plus wetting agent	2 lb. amitrole-T, 4 to 6 lb. of monuron or simazine, 6 fl. oz. weeting agent, and 100 gal. water	50 to 100 gal. per acre or spray to wet foliage	1
Perennial weeds	Herbicidal oils	Undiluted	100 to 200 gal. per acre or spray to wet foliage. Repeat every 2-4 weeks as necessary	6 to 10
	Herbicidal oil plus PCP or DNBP	2 pt. of PCP or DNBP per 100 gal. of oil	Spray to wet foliage	5 to 9
	2,4-D amine plus dalapon plus wetting agent	2 lb. acid equivalent of 2,4-D, 5 lb. of dalapon, 15 fl. oz. of wetting agent, and 20 gal. of water	20 gal. per acre. Use only on vegetation less than 12 inches high	3 to 5
	2,4-D amine plus dalapon plus wetting agent	2 lb. acid equivalent of 2,4-D, 15 lb. dalapon, 6 fl. oz. of wetting agent, and 100 gal. of water	100 gal. per acre or spray to wet foliage	1 to 3

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[1] The active ingredients of these herbicides may be available under different trade names. The amounts of active ingredients should approximate those listed, or changes in the amounts should be made to compensate for differences.

Monuron should not be used near desirable trees and ornamentals or where it may come into contact with the roots of these species by water movement. Although less hazardous than monuron, the other soil sterilants should be used with care around valuable plant species or on ditchbanks, turnrows, etc., where water movement may carry them into other areas. Instructions and precautions given on the manufacturer's label should be strictly observed.

Methyl bromide, SMDC, and DMTT are temporary soil sterilants, and as soon as the danger period elapses, desirable plants may be seeded or transplanted into the treated area. Methyl bromide is extremely poisonous and must be handled very carefully. A more detailed account of the use, precautions in handling, and application of methyl bromide is given under Specific Weeds, Nutsedge. The uses and methods of application of SMDC and DMTT are discussed under New Lawn and Turf Area Establishment. The appropriate section should be consulted before using these herbicides. Instructions and precautions on the manufacturer's label should be followed exactly.

General contact weed control means the kill of the leaves and stems of weeds to the ground level. Roots and rhizomes are usually not killed and regrowth, particularly of perennial weeds, may occur readily; this differentiates general contact weed control from soil sterilization. Annual weeds may regrow depending on the vigor of the root system and the completeness of kill of the top growth.

In choosing between soil sterilization or general contact weed control, the user must consider the effectiveness of the chemicals, the initial cost, and the need and cost of subsequent applications. The kind and amounts of herbicides, additives, and carriers and the number of applications for seasonal control for general contact weed control are given in Table 15. Some of the herbicides in Table 16 are soil sterilants at high rates. Good control with the herbicides listed in Table 16 for one or more seasons may render a soil area sterile. The intermittent killing of the regrowth with herbicidal oils or oils plus PCP or DNBP spaced 2 to 4 weeks apart during the growing season reduces the vigor of root systems, even of perennial grasses, and eventually results in death of most plant roots and rhizomes.

Sorghum

The weed control problem in sorghum is very similar to that in corn. Sorghum seedlings are not as vigorous as corn seedlings. Special care should be given to pre-planting seedbed preparation. If weed control is good until sorghum is about four weeks old, sorghum will usually provide enough shade to smother most of the late season annual weeds. Planting at a uniform depth of one inch in moist, heavy soils to two inches in dry, sandy soils helps to insure an early, uniform stand. Deeper planting delays emergence of sorghum and control of small weeds by competition may be unsatisfactory. The first cultivation should be shallow and done as soon as possible in order to control the annual weeds in the drill.

At present no pre-emergence herbicide is recommended for use in sorghum.

Post-Emergence Treatment

A fair measure of broadleaf weed control may be obtained from the use of 1/3 lb. per acre of an amine 2,4-D. Sorghum is susceptible to 2,4-D damage and treatment should be applied when the plants are from 4-12 inches tall. The same precautions as outlined for weed control in corn concerning nearby 2,4-D susceptible crops should be observed. Drop nozzles should be used to place the spray near the ground and avoid spray contact on the sorghum leaves as much as possible.

Flame cultivation similar to that in corn may be used in sorghum. The first treatment may be made after the sorghum is about 8 inches high. After the equipment is adjusted as to burner angle, pressure and speed, two to rour rows should be flamed the day before it is planned to flame the entire crop. The effects of this trial will be evident in a short time and indicate any adjustments which should be made.

Soybeans

Pre-Planting Treatment

Since soybeans are planted in late spring or early summer, shallow pre-planting cultivation may be used as a means of controlling one or more crops of early weeds. Very shallow disking, plowing, use of harrows or rotary hoes or tillers should destroy the weeds and form a shallow mulch. Where annual weeds such as crabgrass, Brachiaria, goosegrass, pigweed, and annual morningglory present early-season weed problems the use of herbicides may be warranted. Two kinds of treatments for controlling these weeds are recommended.

Pre-Emergence Treatment

NPA, and Na-PCP are recommended for trial use on soils having textures of medium sandy loam to clay loams .Rates for various soil types are presented in Table 17.

Seed preparation and application of sprays should be done in the same manner as recommended for cotton. The seed should be covered at least one inch deep. The pre-emergence treatment is not recommended for use on extremely sandy soils or on heavy clay soils such as Sharkey, Houston, etc.

A new pre-emergence herbicide for soybeans, amiben, will be commercially available in 1961 for use on soybeans produced for seed only. This material has been tested during two seasons in Mississippi and appears to be an excellent pre-emergence herbicide for soybeans.

Post-Emergence Treatment

A single directional spraying with one of the herbicidal oils recommended for cotton has given good control of most young annual weeds in soybeans when applied correctly and at the proper time. An oil treatment of 5 gallons per acre when the soybeans are from 12 to 16 days past emergence and applied exactly as prescribed for use in cotton is recommended where no pre-emergence chemical is used and an early annual weed problem exists. Under no conditions should the rate of 5 gallons per acre be exceeded.

A rotary hoe may be used as soon as soybeans are up to a stand. Repeat as needed at about 5-day intervals. Rotary hoe should be used when grass and weeds are breaking through the soil.

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When soybeans are in first trifolium (one pair of true leaves) through second trifolium (two pair of true leaves) wait until beans have some loss in tugor (slightly wilting), this usually occurs in late morning or near noon, before starting rotary hoe. Do not use rotary hoe after beans have their second trifolium fully expanded.

Table 17. Rates of NPA, Na-PCP, and amiben for pre-emergence weed control in soybeans.

	Lb/A on 12-inch band[1]		
Soil texture	NPA	Na-PCP	Amiben
Medium sandy loams	0.6	3.0	0.7
Very fine sandy loams	0.9	4.0	0.9
Silt loams	1.2	5.0	1.1
Clay loams	1.8	6.0	1.3

[1] Applies only where rows are 40 inches wide.

Specific Weeds

Nutsedge (Nutgrass or Coco)

Nutgrass, or coco, can be eradicated in small areas, such as lawns, flower beds, and gardens, by the use of methyl bromide. The method is too expensive and laborious for field use. The methyl bromide treatment also kills Johnsongrass, Bermudagrass and many weed seeds. There is some evidence the nematode populations are reduced by methyl bromide fumigation.

Best results from the treatment are obtained when the soil is warm (above 50° F), moist but not wet, and has been spaded to a depth of about 10 inches. The spaded area to be treated is covered with a gas-proof cover, such as 6 mil polyethylene or rubberized tarpaulin. The cover must be tight; any holes in it should be closed with gummed tape. One pound of methyl bromide per 100 square feet soil surface should be released under the cover into an open container. The area should remain covered for at least 48 hours. The treated area may be planted safely about two to three days after the cover is removed.

Approximately 100 percent control may be expected, but an occasional tuber may escape. Do not let these few escaped "nuts" reinfest the area, as they will quickly do if left alone. Remove them at once.

Methyl bromide is poisonous and must be handled with care. The manufacturer's precautions must be observed. The chemical is odorless, but some commercial preparations contain added materials such as tear gas which give an odor that is easily detected. With proper care in application one can use methyl bromide in the open with very little risk. Methyl bromide may be obtained from several chemical manufacturers. One manufacturer is distributing it in small trial application kits. The cost is about $1.00 a pound.

Sweetpotatoes employed as a competitive crop in combination with cross-cultivation has practically eradicated nutgrass in three years. The procedure is: (1) Disk the area several times prior to setting out the potato slips. (2) Plant the potatoes in hills on 40-inch centers on flat seedbeds; three slips per hill are adequate. (3) During the first cross-cultivation off-barr the potatoes both ways with disk hillers. (4) For the second cross-cultivation use scratchers or sweeps with fenders. Use this method as many times as potato vines will permit; about twice has been the limit. Harvest the potatoes late in the fall just prior to frost. Excellent yields of potatoes have been produced in this manner.

For spot infestations of nutgrass soil sterilants may be used.

Cypress Weed (Texas Cedar)

Use 2½ to 3 pounds of 2,4-D or 1½ pounds of 2,4,5-T per acre in 10 to 20 gallons of water as a broadcast spray. Where infestation is not heavy enough to justify broadcast spraying at these rates, spot spraying of small patches of individual plants may be advisable. Treat in late spring or early summer when plants are in active growing condition.

The above rates of these chemicals will severely injure or kill lespedeza, clovers, and other legumes. Avoid drift on to susceptible crops such as cotton.

Johnsongrass

The method to use in controlling Johnsongrass depends largely upon where the weed occurs and the extent of the infestation.

Heavy Infestation in Cropland: No satisfactory chemical is known for controlling a heavy infestation of Johnsongrass in a growing crop. In situations where it is impractical or too expensive to chemically treat individual crowns or clumps of Johnsongrass because of large numbers of the weed, cultural methods of control are suggested. The most effective cultural control has been summer fallow plowing 3 to 8 times at 2 to 4 week intervals. The number and intervals of the plowings or diskings are determined by the rate of growth of the grass. In no case however, should the Johnsongrass be permittted to produce open seedheads. Research has shown that essentially all of the underground growth of Johnsongrass, roots and rhizomes, occurs after the plants come to full bloom. Because of this it is best to plan a program whereby fallowed fields could be cultivated whenever the plants are 20-24 inches tall.

A program that has proven successful in many areas has been to grow winter oats for grain and begin the summer cultivation after harvest. The oats should be well fertilized so that Johnsongrass emerging before harvest will be retarded by the crop. Cross-plowed cotton is an excellent crop following a fallow program.

If it is not possible to fallow during the summer, two winter fallow plowings. one in early November and one in January, will reduce the Johnsongrass population to some extent.

Light Infestation in Cropland: In cases of a light infestation, or one which has been reduced by the above methods, small scattered clumps of grass should be spot treated with any one of the following materials, a naphtha-type oil, diesel fuel containing 0.25 percent pentachlorophenol or a solution of dalapon.

The naphtha-type oil or diesel fuel containing PCP should be applied to Johnsongrass crowns 2 to 6 times per season to prevent plants from heading. Dalapon should be prepared by dissolving one pound of dalapon in 5 gallons of water and adding enough wetting agent to equal 0.5 percent of the total volume. Young plants should be sprayed to run-off with the solution but large plants that have headed should be cut to the ground and the new growth treated with dalapon. Generally Johnsongrass is much easier to kill or control with dalapon if treated before plants reach full bloom, and become progressively harder to control after reaching full bloom.

In any clean-up program every effort should be made to prevent Johnsongrass from producing seed, not only in the field itself but also along the turn rows, drainage ditches and fence rows. Any seed produced will threaten reinfestation of areas free of the weed.

Johnsongrass in Non-Cropland: Small clumps of Johnsongrass around storage buildings, shopyards, etc., may be treated with either oil sprays or dalapon as previously discussed.

Johnsongrass growing in fence rows, along ditch banks, and in drainage ditches may be controlled by applying 400 to 600 pounds per acre of sodium chlorate in solid form or as a spray to which 200 pounds of calcium chloride has been added. The calcium chloride reduces the fire and explosive hazard of the sodium chlorate. Respraying or spot treatment should be done as required to kill any Johnsongrass escaping the first application. In the handling of sodium chlorate great care should be exercised to follow in detail the instructions on the label of the container. While sodium chlorate is generally the most economical soil sterilant, there are a number of other soil sterilants that will control Johnsongrass. For information on these materials see the section on Soil Sterilants. Johnsongrass may also be controlled in non-cultivated areas by the application of dalapon at the rates of 10 pounds per acre for the first application and 5 pounds per acre for subsequent applications. The chemicals should be applied in at least 20 gallons of water to the foliage when the Johnsongrass is about a foot high and repeated as often as is needed. This herbicide has little residual action and yearly treatment will be necessary.

Wild Onion

Before using the following recommendations for wild onion control, care should be taken to make sure that the actual weed present is wild onion and not wild garlic. These two weeds look quite similar in growth habit and often difficult to distinguish between even by trained workers. The control measures listed are much more effective on wild onion than on wild garlic and in some cases will give no control of wild garlic. Limited evidence indicates that wild garlic is far more common in Mississippi than wild onion.

Good control of wild onions can be obtained by spraying with MH at the rate of 3 pounds in 20 gallons water per acre. This chemical is most effective when applied in late fall when a high percent of the onions have germinated and have shoots above the ground. Dormant bulbs will not be affected by the chemical. One should dig up several clusters of onions and examine them for dormant bulbs and make the spray application when practically all the bulbs have shoots above the ground. A spreader and sticker must be incorporated in the spray solu- good retention of the spray.

Until more information is available, MH should not be used on pastures sown for winter grazing. Farmers using this herbicide should follow the manufacturer's instructions on the label of the container.

In instances where wild onions present problems in produucing certified seed of small grains an application of 2,4-D may be warranted. A low volatile ester of 2,4-D should be applied at a dosage of 1½ lb. per acre in 20 gallons of water. This treatment usually prevents the development of the troublesome onion heads which contaminate the grain. Application should be made when onions have emerged to a maximum stand but before the stems of the small grains have elongated. Some injury to the crop may result from the 2,4-D ester but this is usually more than offset by the benefits derived from preventing the onion head development.

For wild onion control in established permanent grass-legume pastures, two applications each year of 2,4-D for 2 or more years may be required. The first application of one pound per acre should be during the period October to December, and the second application of one pound per acre during the period February to the first part of April. If injury to legumes is not a consideration, two pounds per application is more effective.

For small areas such as lawns, flower beds, and gardens the methyl bromide treatment described for nutgrass may be used.

Equipment For Weed Control

General Spray Equipment

The sprayers discussed in this publication are tractor mounted or pulled behind, aircraft, mist blowers, and hand applicators.

Most of these sprayers consist of a pump, delivery hoses, tank or tanks, flow regulators, pressure gauge, boom or individual mounted nozzles. There are many variations in sprayers to adapt them for a specific use.

Pumps: Pumps used for weed control are usually power take-off driven and run at speeds near 500 r.p.m. They are required to pump solutions, emulsions, suspensions of wettable powder, and petroleum products at pressures rarely exceeding 40 pounds per square inch.

Used for weed control spraying in Mississippi have been roller, diaphragm, gear and piston type pumps. A few centrifugal pumps have been used. Normal PTO speed has not been sufficient to use centrifugal pumps directly connected, although some have been driven from the tractor belt pulley.

Roller pumps are widely used in Mississippi and are satisfactory for several spraying jobs. Where an abrasive mixture is being pumped, rapid wear may be encountered with the roller pump. The rate of wear will be influenced by the abrasiveness of the wettable powder, the concentration of the mixture, and whether the powder is kept in suspension at all times. Good agitation will reduce the rate of pump wear in pumping suspensions of wettable powder.

Deterioration of rubber diaphragms and rubber seals in pumps has been encountered when pumping petroleum products such as herbicidal oil and certain solvents used with insecticides.

When the pump has been selected, proper care in use and storage will lengthen the useful life tremendously.

Important considerations in selecting the pump are:

1. Selection of a pump which will supply enough material for the nozzles plus an amount sufficient for agitation. A by-pass of 3 G.P.M. through a special agitator will usually keep the wettable powders now recommended, agitated within a 50-gallon tank. Shape and size of tank, pressure and location of hydraulic agitator, and volume being by-passed are factors which influence degree of agitation.

2. Will the material to be pumped corrode or deteriorate pump parts exposed to chemical?

3. Can the pump be repaired easily without specialized tools?

4. Availability of service and replacement parts.

5. Will pump capacity be reduced by wear?

6. Can pump be restored to original capacity by replacing worn parts?

7. Weight and size of pump.

8. Initial cost.

Many pumps are severely damaged by hammering them on and off the power take-off shaft. The shaft should be cleaned with a steel brush to remove grease and dirt and burs should be removed with a fine file before installing the pump. Do not operate the pump when the tank is empty for serious damage to roller and gear pumps can result.

Hoses: Sprayer hose should be resistant to aromatic petroleum solvents. The hoses leading from the tank to pre-emergence and post-emergence nozzles should be of equal length and size. Sharp kinks in the hose should be avoided. Hose fittings should have adequate openings to avoid restrictions in the lines.

Pressure Regulators: The regulator should be of a type that will hold the pressure constant with a minimum amount of pulsation. Most regulators have a fitting attachment for the pressure gauge. The gauge should give an accurate reading since pressure is a vital factor in controlling the amount of material being applied.

Tanks: The basic containers have been 5^c gallon mild steel oil drums. Many commercial sprayers are sold without containers. There are tanks of mild steel, stainless steel, aluminum, aluminumized steel, and plastic reinforced with fiberglass. All tanks should have a means of getting into them for thorough cleaning and treating the tank, if need be, against corrosion. Field tests have shown that nozzle stoppage will be negligible when corrosion resistant materials such as stainless steel are used in tank construction and feedlines. Any tank that has rusted or corroded should be replaced to insure proper operation of the sprayer. Tanks should have a means for properly installing by-pass lines which provide correctly installed hydraulic agitation. A good drain should be installed at the lowest point in the tank for easy cleaning and rinsing.

Strainers: A line strainer (50-mesh) should be installed on the intake side of the pump. Fifty-mesh screens should be placed just behind each nozzle tip of greater capacity than 0.1 gallon per minute, and 100-mesh screens should be used for tips smaller than these.

Special Applicators

Pre-emergence: If herbicidal oils are not to follow pre-emergence herbicides, a simple drop-nozzle back of the press wheel is all that is needed. If herbicidal oils are to follow pre-emergence herbicides, a flat roller behind, or in lieu of, the split press wheel is necessary. Width of the treated band is controlled by adjusting the height of the nozzle (about 7 inches for a 12-inch band).

Post-emergence Oil Applicators for Directed Sprays and Cultivation Equipment

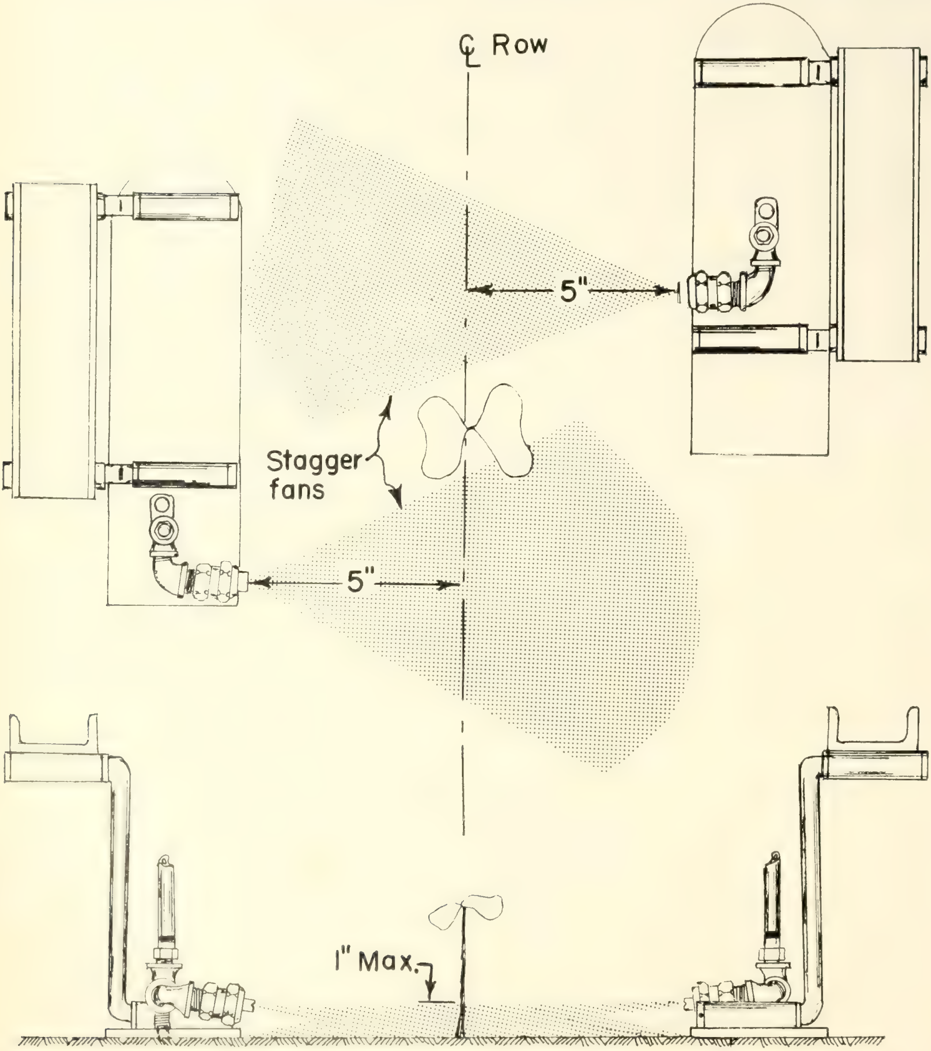


Figure 1. Nozzle setting for post-emergence oil application.

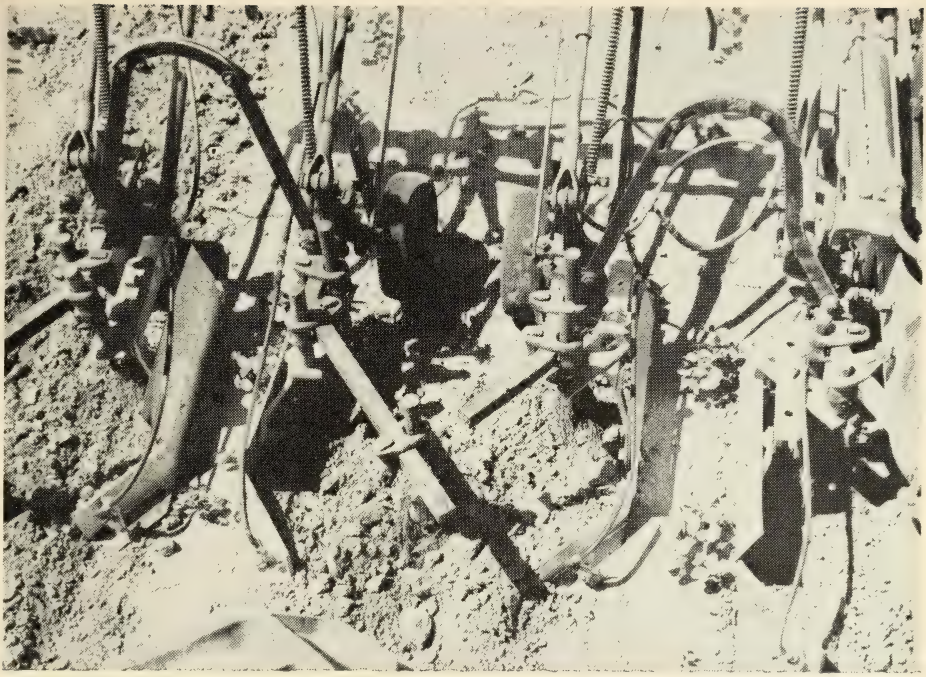


Figure 2. Fender type post-emergence oil applicators, used with high speed sweeps.

for Preserving Treated Bands: Cultivation of the side of the row next to the treated band and application of the oil are normally combined. The operations can be separated, however, and this will be advantageous when the fields are too wet to cultivate, but are dry enough to permit application of the oil. Cloddy beds, uneven beds, extremely dry and powdery soil and other undesirable field characteristics will affect adversely the performance of all types of equipment. Some of these conditions can be prevented largely by good seedbed preparations and maintenance of correct equipment settings; for others no preventive measures can be taken, but they can usually be overcome by special setting of equipment. Any such special setting of equipment should not change the rate or method of oil application. Regardless of the equipment or methods used, the oil application and cultivation should insure proper placement of the oil, effectively join cultivation of the middles to chemical control in the treated band, keep loose soil and clods out of the drill area, and leave the shoulder of the treated band smooth and level so that future applications of oil or flame can be made. Spacings of nozzles and cultivating implements presented in Figures 1 to 8 apply to all types of implements. The oils must be applied from fan-type nozzles. Several types of equipment are available, and of which the following are generally typical:

1. **Parallel-action Shoes and Shield-type Sweeps (Figure 1):** The shoes serve as carriers and gauges for the spray nozzles and may be bolted to the shank of the shield sweep. With the sweep at the proper depth in the soil, the front of the shoe should be about 1/8 inch off the ground, with the rear part firmly on the soil. The parallel arms should be pointed backward at an angle of 45 degrees. The shield-type sweeps are used

to cultivate the area next to the treated band. They should be set with the shield section parallel to the row, or with the leading end pointing very slightly toward the row ("toed-in at the front"). They should be set deep enough to cut the weeds just below the soil; neither sliding over the tops of the weeds, nor passing so far beneath the roots that the weed is not cut (about 1/2 to 3/4 inches deep). These shield-type sweeps may be used without the oil applicators for cultivation or cross-cultivation where it is necessary to protect a treated band from loose soil. Drawings for these applicators are shown in Mississippi Agricultural Bulletin 576.

2. **Parallel-action Fenders and Broad-Angle, Low-Crown, High-Speed Sweeps Figure 2.):** These fenders serve as carriers and gauges for the spray nozzles, and to protect the drill area from loose soil. Each fender is placed to the inside of a front sweep, with the midpoint (lengthwise) of the applicator just opposite the tip of the sweep wing. The front of the fender should be about ¼ inch higher than the rear, and the parallel arms should point backward at a 45 degree angle when in the operating position. This position allows the fender to move up or down with the contour of the row.

The high-speed sweeps should be set relatively flat and shallow, and are used to accomplish the same job as the shield-type sweeps. Likewise, they can be used in combination with the fenders when no oil is being applied.

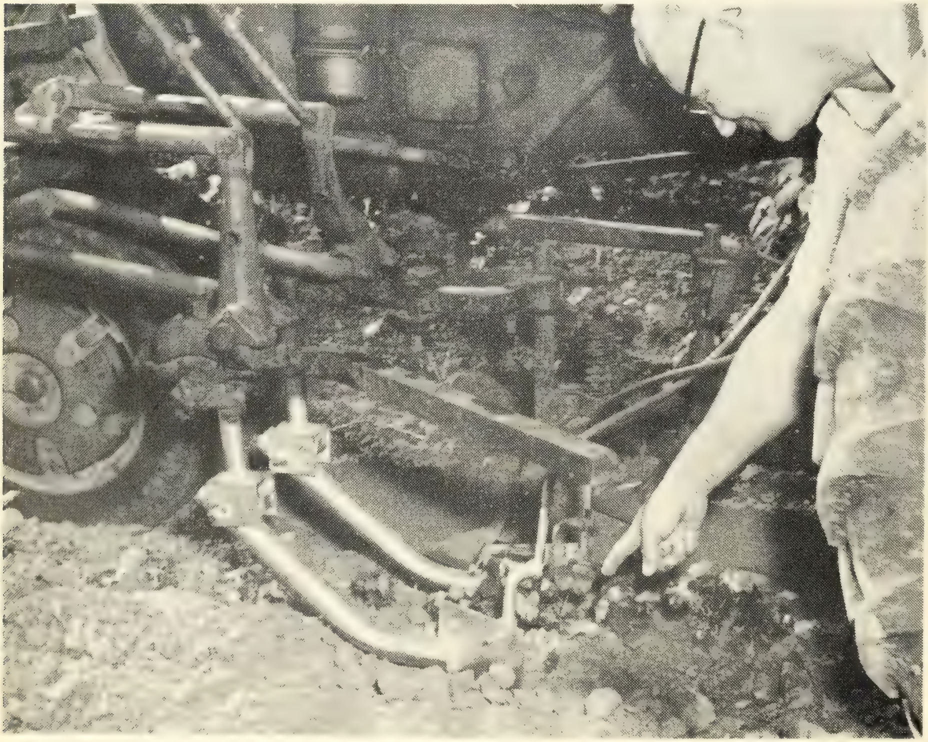


Figure 3. A simple post-emergence chemical shoe used to apply chemical in cotton, corn, and other row crops.

3. **A Single Hinge Heavy Bar Post-emergence Chemical Shoe:** This was designed for use in the hill section of Mississippi where equipment must often be turned over terraces and road ditches. (Figure 3).

For best results in the hill area the first application of post-emergence chemicals should be made before the first cultivation and as a separate operation. It was found that for all field conditions in the hill area, the nozzles should be set 5 inches away from the plant on each side of the row, at 120 degrees to 160 degrees with forward direction of travel and set high enough to permit a 30 degree tilt downward and still cover the desired width band. The tips should be set at a side slope so that the chemical will normally hit 1 inch about the base of the plant and lap at least 2 inches or more across the drill.

4. **Rotary Shields:** Rotary Shields combined with high-speed sweeps also offer a simple way of cultivation, cross-cultivation, and protection of a treated band when no oil is being applied. These shields are made by bolting a circular piece of metal (½ inch smaller in diameter than the rotary hoe) to each outside hoe of a 4-hoe rotary hoe. The two inside hoes are removed.

5. **Subsurface Sweeps:** A subsurface sweep used to prevent dirting has proven to aid materially in cultivating crops without causing soil to be moved into the chemical band area which would inhibit post-emergence chemical or flaming being applied in an effective manner. See December Farm Research, 1960.

6. **Disk-hillers:** Disk-hillers (Figure 7) are particularly effective for cultivation, cross-cultivation, and protection of

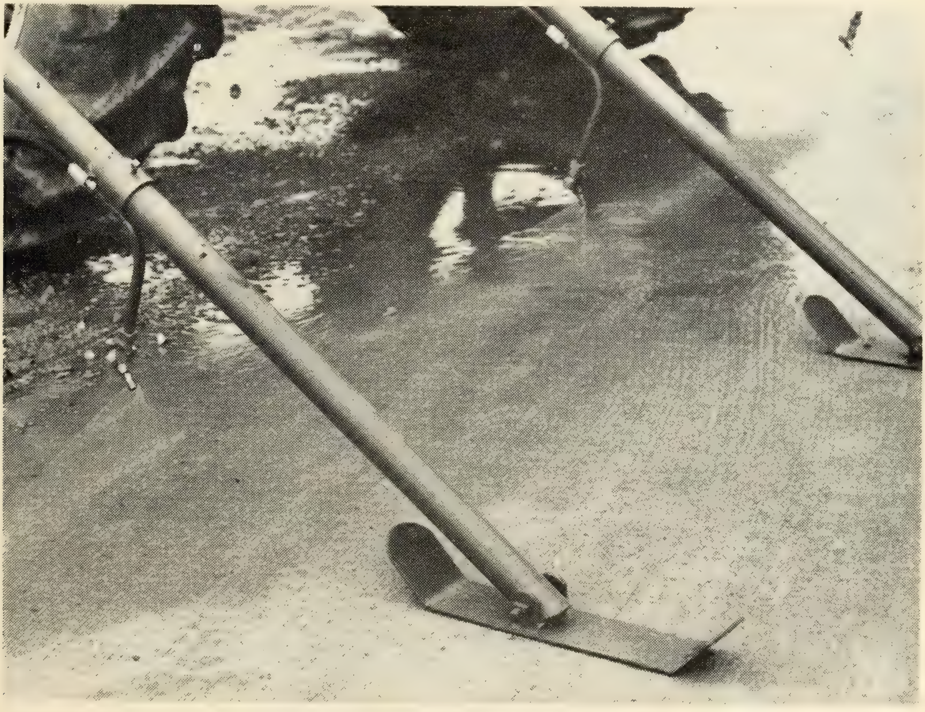
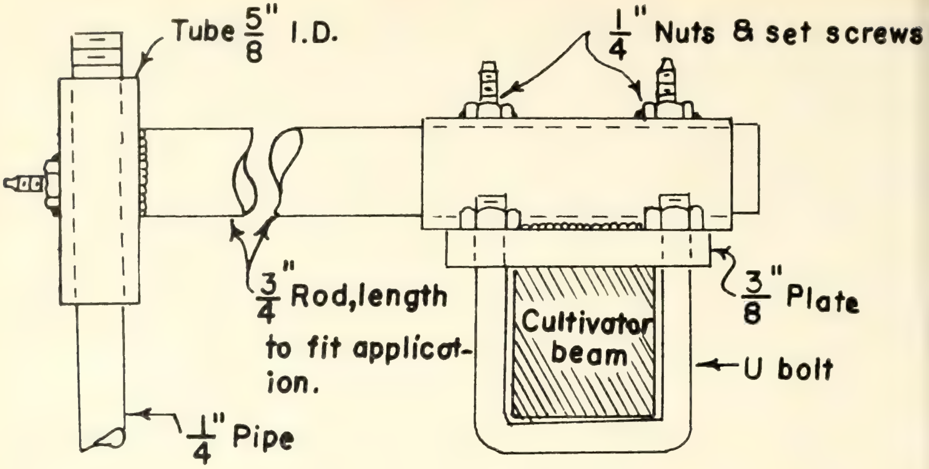
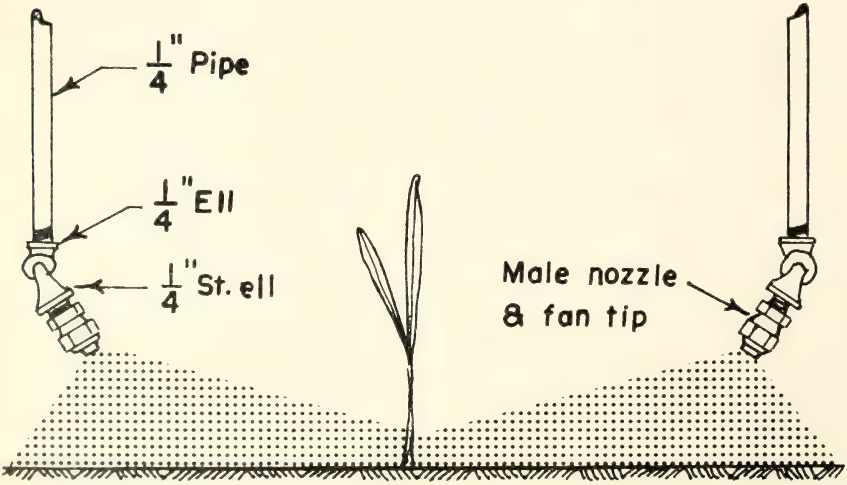


Figure 4. Angle set drop nozzles mounted on flame cultivator beam for applying post-emergence spray in cotton middles.


Tube $\frac{5}{8}$" I.D.
$\frac{1}{4}$" Nuts & set screws
$\frac{3}{4}$" Rod, length to fit application.
$\frac{3}{8}$" Plate
Cultivator beam
U bolt
$\frac{1}{4}$" Pipe

BRACKET FOR POST—EMERGENCE APPLICATION
2 REQ. PER ROW


$\frac{1}{4}$" Pipe
$\frac{1}{4}$" Ell
$\frac{1}{4}$" St. ell
Male nozzle & fan tip

SCHEMATIC OF NOZZLE POSITION

Figure 5. For corn — Nozzle position as shown.

a treated band when no oil is being applied. They should be run just deep enough to clear out the weeds. A following sweep is used to refill the trench left by the disk-hiller.

Lay-by Equipment and Semi-directed Post-emergence Applicators: Lay-by or late season, herbicides have been applied with two general types of equipment. The most common is a nozzle or pair

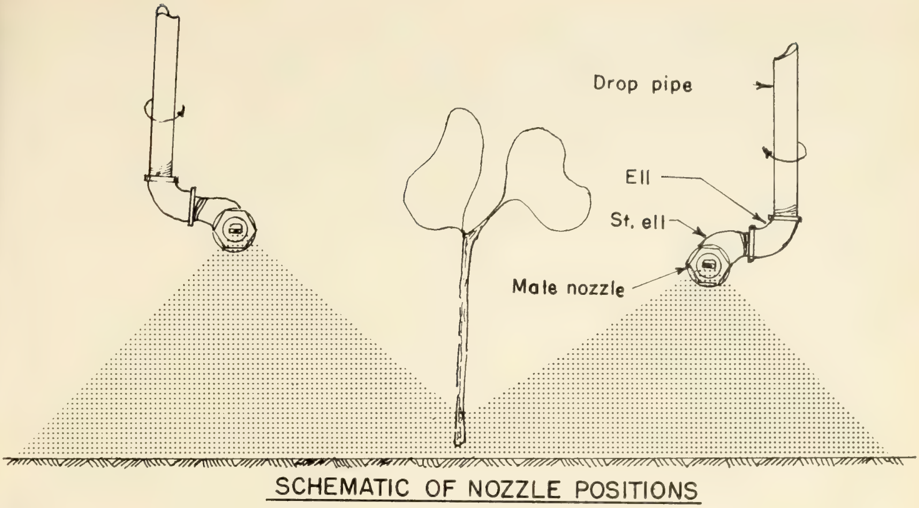


Figure 6. For cotton — nozzles turned to rear. Drop pipes rotated to lap sprays. Street ell tilted down to control height spray strikes cotton stems.

of nozzles supported by shoes on a skid. This type has been mounted on either a modified flame cultivator or a rig manufactured specifically for this purpose (Figure 4). A second method is to attach a nozzle behind each sweep that cultivates the middle.

On both types of applicators, the nozzle or nozzles must be adjustable in height and angle. One or two wide angle nozzles are used. They are positioned to cover the entire row and low enough to miss the lower foliage of the crop. Volume of spray for this type application varies from 25 to 40 gallons per acre.

A method of applying a semi-directed post-emergence spray is shown in Figure 5. Rigid drops are secured directly to the cultivator gang beams. Gauging is provided by the gauge wheels of the

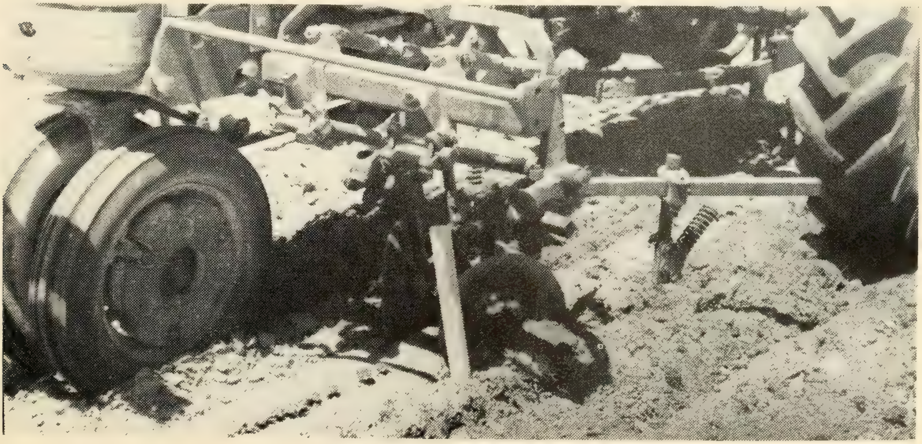


Figure 7. Disk-hillers.

cultivator. Two suggested methods of nozzle settings are shown.

The first method of setting the nozzles is recommended primarily for application of 2,4-D post-emergence in corn. The second method may be recommended for post-emergence application of contact herbicides (other than herbicidal oils) for use in cotton or soybeans when and if suitable herbicides can be recommended.

Flame Cultivators: See Mississippi Agricultural Experiment Station Bulletin 545.

Boom-type Sprayers: Boom-type sprayers may be equipped with two long-drop nozzles per row for spraying corn, or may be used with short drops for spraying in small grains, rice, smooth pastures, and other operations.

As a general rule, broadcast booms for weed control should be fitted with fan type nozzles tips that produce a heavy-center spray pattern (conventional type) so that over-lapping of the patterns does not produce strips that are double sprayed, as would be the case with even-distribution tips.

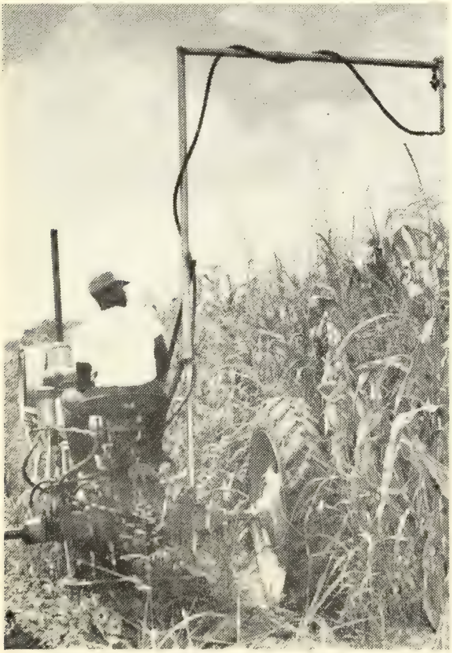


Figure 8. A method used to apply chemicals over the top of corn for late weed control.

Boomless Sprayers: This type sprayer consists of a cluster of nozzles in a single fitting. They are useful over rough terrain and where even spray distribution is not essential. Wind is a factor in using these nozzles. Spraying on a windy day requires extra precautions to obtain good coverage and to avoid drift hazards.

Calibration charts should be consulted under the column "Total Capacity in G.P.M." to be sure that the pump on the sprayer has an adequate capacity.

Post-emergence Equipment for Overhead Broadcast Treatment with Chemicals in Corn and Other Tall Crops: This is a new method of applying chemicals in corn to control weed growth late in season after the corn has begun to ripen. It was found that twenty rows of corn could be sprayed in one round with jet boom nozzles. Two rows of soybeans were planted for every 20 rows of corn so that the tractor could pass over the soybean rows. A one side delivery jet boom was mounted 11 feet high and 6 feet out for the mounting on the rear tractor housing. A 2-inch piece of pipe supported the jet boom (Figure 8). The spray was applied at 20 to 30 pounds pressure when there was very little air movement.

Calibration of Spray Equipment

All spray equipment should be calibrated. Good calibration will insure the correct dosage to control weeds, eliminate damage to crops caused by the application of too much chemical, as well as avoid extra costs due to excess rates.

Pre- and Post-emergence Equipment for Band Treatments: Total volumes of spray application for pre-emergence herbicides can usually range from 6 to 12 gal./A on a 12-inch band without appreciable differences in results. Some researchers have reported, however, that in some tests total volumes less than 12 gal./A gave poorer weed control than the more standard rate of 12 gal./A. Calibration is also more critical with the lower volume of application.

Calibration of a spray machine is easy and simple, if confusing factors are not added.

The rate of application for this type of spraying depends upon speed of machine, size of nozzle, and pounds of pressure. The number and spacing of nozzles is constant for pre-emergence spraying (1 per row) and for post-emergence spraying (2 per row), and therefore will not need to be considered in the use of this calibration procedure. The actual width of the rows can also be ignored since this calibration table can be used for all row widths. If the rows are wider or narrower than 40 inches, the amount of herbicide used per acre will

Table 18. Calibration data for pre- and post-emergence herbicidal sprays.

M.P.H.	Seconds to travel 300 ft.	Nozzle sizes[1]	Approx. gauge pressure (p.s.i.)	Seconds to fill 1 qt. from 1 nozzle	Nozzle sizes[1]	Approx. gauge pressure (p.s.i.)	Seconds to fill 1 qt. from 1 nozzle
		PRE-EMERGENCE APPLICATIONS					
	12 gals./acre[2] water solution				6 gals./acre[2] water solution		
2.2	93	8002	32	84	8001	32	168
2.4	85	8002	38	77	8001	37	154
2.6	79	8003	20	71	8001	45	142
2.8	73	8003	23	66	80015	22	132
3.0	68	8003	26	62	80015	26	124
3.2	64	8003	30	58	80015	29	116
3.4	60	8003	34	55	80015	33	110
3.6	57	8003	38	52	8002	21	104
3.8	54	8004	24	49	8002	23	98
4.0	51	8004	26	46	8002	26	92
4.2	49	8004	29	44	8002	30	88
4.4	46	8004	32	42	8002	33	84
4.6	44	8004	35	40	8002	36	80
4.8	43	8004	38	39	8002	38	77
5.0	41	8004	41	37	8002	40	74
		POST-EMERGENCE OILS					
	5 gal./acre[3]				7 gal./acre[3]		
2.2	93	800050[4]	17	404	650067[4]	18	289
2.4	85	800050	20	370	650067	22	266
2.6	79	800050	24	342	650067	26	245
2.8	73	800050	27	318	650067	30	227
3.0	68	800050	32	297	650067	34	212
3.2	64	650067	20	278	8001	18	199
3.4	60	650067	23	262	8001	20	188
3.6	57	650067	25	247	8001	22	177
3.8	54	650067	28	234	8001	25	168
4.0	51	650067	31	222	8001	27	159
4.2	49	650067	34	212	8001	30	152
4.4	46	8001	15	202	8001	33	144
4.6	44	8001	19	193	80015	16	139
4.8	43	8001	20	185	80015	18	133
5.0	41	8001	22	178	80015	19	127

[1] Other type nozzles with correct degree of angle and orifice size may be substituted for nozzles listed.

[2] Total gallons solution per acre on 12-inch band with rows spaced 40 inches apart, 1 nozzle per row.

[3] Total oil per acre with rows spaced 40 inches apart.

[4] Two nozzles required per row for herbicidal oils.

Table 19. Calibration for broadcast spraying in gallons per acre with nozzles spaced 20 inches apart.

Nozzle size	Pressure	Speed in miles per hour[1]														
		2.6	2.8	3.0	3.2	3.4	3.6	3.8	4.0	4.2	4.4	4.6	4.8	5.0	6.0	7.0	8.0
	20	8.0	7.6	7.1	6.6	6.2	5.9	5.5	5.2	5.0	4.8	......	......	......	......	......	......
	30	10.4	9.7	8.6	8.5	7.9	7.6	7.1	6.8	6.4	6.1	5.8	5.7	5.1	......	......	......
8001	40	11.5	10.8	10.0	9.4	8.8	8.4	7.9	7.5	7.1	6.8	6.5	6.3	6.0	5.0	......	......
	20	12.6	11.9	10.5	10.3	9.7	9.2	8.7	8.2	7.8	7.5	7.2	6.9	6.3	5.5	......	......
	30	15.0	14.0	12.9	12.2	11.4	10.9	10.3	9.8	9.2	8.8	8.4	8.2	7.7	6.5	5.6	......
80015	40	17.2	16.2	14.9	14.1	13.2	12.6	11.8	11.2	10.6	10.2	9.8	9.4	8.9	7.5	6.4	......
	20	16.1	15.1	14.0	13.2	12.3	11.8	11.1	10.5	9.9	9.5	9.1	8.8	8.4	7.0	6.0	5.2
	30	19.6	18.4	17.2	16.0	15.0	14.3	13.4	12.8	12.1	11.6	11.0	10.7	10.3	8.5	7.3	6.3
8002	40	23.0	21.6	19.8	18.8	17.6	16.8	15.8	15.0	14.2	13.6	13.0	12.6	11.8	10.0	8.6	7.4
	20	24.2	22.7	20.9	19.7	18.5	17.6	16.6	15.8	14.9	14.3	13.6	13.2	12.6	10.5	9.0	7.8
	30	29.9	28.1	25.8	24.4	22.9	21.8	20.5	19.5	18.5	17.7	16.9	16.4	15.4	13.0	11.2	9.6
8003	40	34.5	32.4	29.6	28.2	26.4	25.2	23.7	22.5	21.3	20.4	19.5	18.9	17.8	15.0	12.9	11.1
	20	......	......	28.0	26.3	24.6	24.5	22.1	21.0	19.9	19.0	18.2	17.6	16.8	14.0	12.0	10.4
	30	......	......	34.3	32.9	30.8	29.4	27.6	26.2	23.8	23.8	22.8	22.0	18.7	17.5	15.0	13.0
8004	40	......	......	39.6	37.6	35.2	33.6	31.6	30.0	28.4	27.2	26.0	25.2	20.6	20.0	17.2	14.8

[1] Speed of tractor should be determined in the manner previously described (see Table 1).

Example: It has been determined that the speed of the tractor is 3.4 miles per hour and a total volume rate of 15 gallons per acre is to be used. Read down under 3.4 in the "speed" column to 15.0; this shows that an 8002 nozzle should be employed at 30 p.s.i. If 2,4-D is to be applied at a rate of 1½ pounds per acre, three pints of the 2,4-D concentrate (containing 4 pounds of acid equivalent per gallon) is added to the 14-3/4 gallons of water.

not be equal to that calculated, but the amount that is actually applied on the band will be the recommended amount.

The procedure for calibrating a tractor sprayer should be as follows: First, get all equipment on the tractor operating in and on the ground properly. Second, time the tractor in seconds over a measured course if 300 feet with the tractor at full throttle in the desired operating gear. Third, from the speed found in feet per second find the speed of the tractor in miles per hour in Table 18. Fourth, read across the table and find correct nozzle or tip size, approximate gauge pressure, and the number of seconds it will take to fill one quart from 1 nozzle.

For Example: The speed of tractor is 300 feet in 68 seconds or 3.0 mph, and it is desired to spray 5 gallons per acre of herbicidal oil. An 800050 size nozzle tip operating at 32 pounds of pressure per square inch would be required. This size nozzle tip at the 32 pounds p.s.i. should deliver 1 quart in 297 seconds. If one quart is not delivered in the time specified, adjust pressure until one quart is filled in the given time. All nozzles of the machine should be calibrated.

Things to be considered for efficient sprayer operation are:

1. Rust free tank and lines.
2. Use clean water in the pre-emergence spray mixture.
3. Strain mixture as it is poured into tank.
4. Wash out the sprayer immediately after each operation and also before next operation if there is any time lapse.

General Broadcast Spraying: 1. **Boom Type Sprayers:** Where rate of application is not critical the data given in Table 19 will provide for reasonably accurate volumes of application, and will serve as an aid in selection of nozzle size and pressure for a specified need. Speed should be accurately determined by the method outlined in Table 18.

Where the rate of application may be critical (as in post-emergence spraying of young corn) an accurate calibration is desirable. Accurately determine the speed of the sprayer as described above. Select the appropriate nozzle size and approximate pressure for the determined speed from Table 19. Then determine the number of seconds to fill one quart from one nozzle at the desired rate of application by use of the following formula:

$$\text{Seconds to fill 1 quart from 1 nozzle} = \frac{89100}{(\text{nozzle spacing in inches}) \times (\text{gal./A}) \times (\text{MPH})}$$

Example: To spray 11 gallons per acre with nozzles spaced 22 inches apart on a spray rig that travels 300 feet in 49 seconds.

a. Speed = 4.2 MPH (Table 7)

b. Nozzle tip and approximate pressure = 8002 at about 30 PSI (Table 8)

c. Seconds/quart =

$$\frac{89100}{(22)\quad(11)\quad(4.2)} = 87.66$$

d. Adjust pressure until one nozzle delivers 1 quart in 88 seconds (check one or all nozzles)

2. **Boomless Sprayers:** Precision spraying is usually not done with boomless sprayers, and therefore use of calculated application data rather than calibration is usually satisfactory. The calibration tables (Tables 20 and 21) are reprinted with the manufacturer's consent.

Herbicide Application with Fixed-Wing Aircraft

In recent years, several kinds of herbicides have been applied by aerial applicators.

With herbicides, more hazards are encountered than with the application of other types of pesticides. Don't neglect the legal aspects of the application job. Both the farmer and the aerial applicator may be liable for damage to neighboring property If in doubt as to the regulations governing the aerial application of chemical, check with your county agent or member of the State Plant Board. Laws are in effect governing types of equipment and timing of the application.

To obtain the best possible job, the

Table 20. "BOOM JET" Spraying Systems, Bellwood, Illinois.

Nozzle No.	OC TIP "A"	VEEJET "B"	VEEJET "C"	Angle "V"	Liquid Pressure p.c.i.	Total Capacity G.P.M.	"L" Feet	GALLONS PER ACRE			
								3 M.P.H.	4 M.P.H.	5 M.P.H.	6 M.P.H.
5430 ¾ 2T0C10	OC 10	¼U 0508HE	¼VV11004	58°	10	2.0	38	8.7	6.5	5.2	4.4
				58°	15	2.5	39	10.4	7.8	6.3	5.2
				61°	20	2.8	39½	11.9	8.9	7.1	6.0
				61°	30	3.5	40	13.9	10.4	8.3	7.0
				61°	40	4.0	40½	15.9	11.9	9.5	8.0
				61°	60	4.9	41	19.2	14.4	11.5	9.6
5430 ¾ 2T0C20	OC 20	¼U 0520HE	¼VV9506	49°	10	4.3	41	17.3	13.0	10.4	8.7
				51°	15	5.3	43	20.2	15.1	12.2	10.1
				53°	20	6.1	47	21.4	16.1	12.8	10.7
				53°	30	7.5	50	24.6	18.5	14.7	12.3
				53°	40	8.6	52	27.3	20.4	16.4	13.7
				53°	60	10.5	54	32.2	24.1	19.3	16.1
5430 ¾ 2T0C40	OC 40	¼U 054HE	¼U 9510	51°	10	8.5	48	29.2	21.9	17.5	14.6
				51°	15	10.4	52	33.0	24.7	19.8	16.5
				53°	20	12.0	56	35.8	26.9	21.5	17.9
				53°	30	14.7	60	40.5	30.3	24.3	20.3
				53°	40	17.0	63	44.5	33.4	26.7	22.3
				53°	60	20.8	66	52.1	38.9	31.2	26.1

materials should be applied in periods of relative calm. Swath widths vary with the flight level of application. The center line of each pass with the aircraft should be flagged in to assure even coverage with the herbicide. Optimum flagging intervals are those that allow a sufficient overlap to maintain a fairly uniform application rate. Insufficient overlap will cause streaks with poor weed control.

The aircraft distribution equipment should be maintained in good working order. If spray equipment is used, positive drip-proof nozzles should be used and maintained. This will help prevent spraying your neighbor's crops while turning. If granular equipment is used, the gate in the hopper should produce a positive cutoff.

Before the first application, the terrain and obstacles in the fields should be surveyed. The best way to fly on the material can then be determined.

Calibration of Aerial Equipment: As with all other types of herbicide application, it is recommended that the aircraft distribution system be properly calibrated. Calibration of air distribution equipment depends on three factors: Speed, swath width, and output of the distributor. The timed discharge of a known weight or gallonage in flight at operating speed is usually the first step in calibration. This unit will either be reduced to gallons of spray, or pounds of granules discharge per minute. Then one formula that can be used is as follows:

$$\text{Acres per minute} \quad \frac{2\ \text{esw x mph}}{1000}$$

$$\text{Rates per acre} \quad \frac{\text{DPM}}{\text{acres per minute}}$$

DPM—discharge per minute, gallons or pounds
esw—effective swath width in feet
mph—miles per hour

Tractor Mounted Mist Blowers

These blowers are compact units which include a gasoline motor fan, housing, pump, pressure gauge, and storage tank with recirculating agitation. The fan housing can be rotated in a 220 degree arc or set to deliver at any angle or direction desired. This housing can be equipped with a single outlet for treating tall trees or for spraying to one side or it can be equipped with a triple-hole outlet that sprays to the rear and will treat brush up to 20 feet in height. The motor on these blowers will fall in the 5 to 12 h.p. class with the most common ones being 9 h.p. The total weight of the machines range from 230 to 250 pounds. The fans will deliver up to 2000 cubic feet of air per minute at velocity up to 190 miles per hour. The tanks have a capacity from 25 to 35 gallons. Details

Table 21. Gallonage chart, Hanson Broadjet BJ 10-20 field spraying cluster (2-BJ 10-20 nozzles and 1 - No. 10 center tip)

Actual Swath in feet	GALLONS PER ACRE AT 40 LBS. PRESSURE			GALLONS PER ACRE AT 60 LBS. PRESSURE		
	3 MPH	4 MPH	5 MPH	3 MPH	4 MPH	5 MPH
68	14½	11	9	17½	13	11
66	15½	11½	9	18½	14	11
64	16	11½	9	19	14	11
62	16½	12	9½	19½	14½	11½
60	16½	13	10	19½	15½	11½
58	17	13	10½	20½	15½	12½
56	18½	13½	11	22	16	13
54	19	14	11	22½	17	13
52	19½	14½	11½	23½	17½	14
50	20	15½	12	24	18½	14½

NOTE: (1) Gallonage calculated to nearest one-half gallon. (2) For 2 MPH GPA figure, double 4 MPH GPA figure. (3) For 1 MPH GPA figure, triple 3 MPH GPA figure.

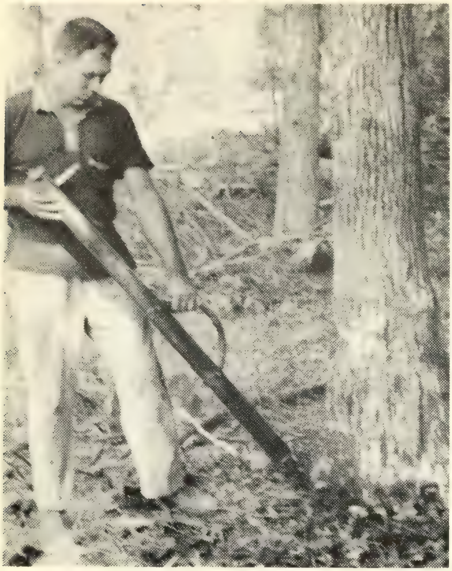


Figure 9. Tree injector showing the the correct position for injection.

on methods of calibration and installation are provided with the purchase of each machine.

Tree Injectors

Injectors generally consist of a hollow steel cylinder with a cut-off valve at one end and a chuck for inserting a cutting bit at the other. In one type of injector the herbicide is carried in the hollow cylinder, in the other type the solution is carried on the back in a back-pack tank. The one where the solution is carried in the cylinder uses gravity to apply the herbicide. Where the solution is carried on the back, pressure is used to apply the herbicide to the cups. The cutting bits on both models are replaceable.

Knapsack Sprayer

The knapsack sprayer is an inexpensive piece of equipment that has many uses. The primary uses of this sprayer in brush control are in the application of foliage or basal spray and the application of herbicide in a frill. The sprayer consists of a tank to carry the solution in, a small hand pump to apply pressure to the solution, and nozzle from which to apply the solution. The nozzle can be changed to give the desired spray pattern.

Mixing Herbicides

The manufacturer's label gives the number of pounds of active material per gallon of the herbicidal concentrate, or for powders, the percentage of active ingredients. Instructions on the manufacturer's label pertaining to personal hazards in handling should be read and strictly observed. The proper amount of the formulated concentrate is mixed with water as set forth in Table 22 below. The concentrate should not be poured into an empty tank; fill the tank about ½ full with water, add the herbicidal concentrate and then complete filling with water. Allow the sprayer to operate with the nozzles cut off, by-passing the liquid through the tank for several minutes to insure thorough mixing.

See Table 22.

Table 22. Amounts of chemical to add to make 50 gallons of spray mix for band spraying on 40-inch rows or for broadcast spraying in general[1].

Crops	Materials	Active ingredient in herbicide concentrate	Soil type	Band or broadcast	Pre- or post-emergence	Spray volume per acre	Chemical to add to make 50 gallons	
						Gallons	Pints	Pounds
Cotton	CIPC	4 lb/gal	Medium sandy loams	12" band	Pre-	12	12	
Cotton	CIPC	4 lb/gal	Very fine loams	12" band	Pre-	12	18	
Cotton	CIPC	4 lb/gal	Silt loams	12" band	Pre-	12	20	
Cotton	CIPC	4 lb/gal	Clay loams	12" band	Pre-	12	24	
Cotton	Diuron	2.8 lb/gal	Medium sandy loams	12" band	Pre-	12	2	
Cotton	Diuron	2.8 lb/gal	Very fine sandy loams	12" band	Pre-	12	3	
Cotton	Diuron	2.8 lb/gal	Silt loams	12" band	Pre-	12	4	
Cotton	Diuron	2.8 lb/gal	Clay loams	12" band	Pre-	12	5	
Soybeans	NPA	2 lb/gal	Medium sandy loams	12" band	Pre-	12	10	
Soybeans	NPA	2 lb/gal	Very fine sandy loams	12" band	Pre-	12	15	
Soybeans	NPA	2 lb/gal	Silt loams	12" band	Pre-	12	20	
Soybeans	NPA	2 lb/gal	Clay loams	12" band	Pre-	12	30	
Soybeans	Amiben[2]	2 lb/gal	Medium sandy loams	12" band	Pre-	12	12	
Soybeans	Amiben	2 lb/gal	Very fine loams	12" band	Pre-	12	15	
Soybeans	Amiben	2 lb/gal	Silt loams	12" band	Pre-	12	18	
Soybeans	Amiben	2 lb/gal	Clay loams	12" band	Pre-	12	22	
Soybeans	PCP-Na	85 per cent	Medium sandy loams	12" band	Pre-	12		15
Soybeans	PCP-Na	85 per cent	Very fine loams	12" band	Pre-	12		20
Soybeans	PCP-Na	85 per cent	Silt loams	12" band	Pre-	12		25
Soybeans	PCP-Na	85 per cent	Clay loams	12" band	Pre-	12		30
Corn	2,4-D	4 lb/gal	All	Broadcast	Post-	10[3]	3 to 5	
Corn	Simazine or Atrazine	80 per cent	Medium sandy loams	12" band	Pre-	12		3
Corn	Simazine or Atrazine	80 per cent	Very fine loams	12" band	Pre-	12		5
Corn	Simazine or Atrazine	80 per cent	Silt loams	12" band	Pre-	12		6
Corn	Simazine or Atrazine	80 per cent	Clay loams	12" band	Pre-	12		8
Pastures	2,4-D	4 lb/gal	All	Broadcast	Pre- or post-	10[3]	7 to 10	
Rice	2,4-D or 2,4,5-T	4 lb/gal	All	Broadcast	Post-	10[3]	8 to 12	
Rice	2,4-D or 2,4,5-T	4 lb/gal	All	Broadcast	Early post-	10[3]	5	
Rice	Silvex	4 lb/gal	All	Broadcast	Post-	10[3]	10 to 15	
Rice	Silvex	4 lb/gal	All	Broadcast	Early post-	10[3]	7	
Smallgrains	2,4-D or 2,4,5-T	4 lb/gal	All	Broadcast	Post-	10[3]	7 to 10	

[1] These figures represent averages; see section on the crop in question for more detailed rate recommendations. Other volumes can be computed by multiplying or dividing amount of chemical for 50 gallons by fractional part needed, that is, for 100 gallons: 2 x amount; for 30 gallons: 3/5 of chemical.

[2] Applications of Amiben must be limited to soybeans grown for seed.

[3] Use ½ of the listed rate of chemical where 20-gallon volume-per-acre is used.

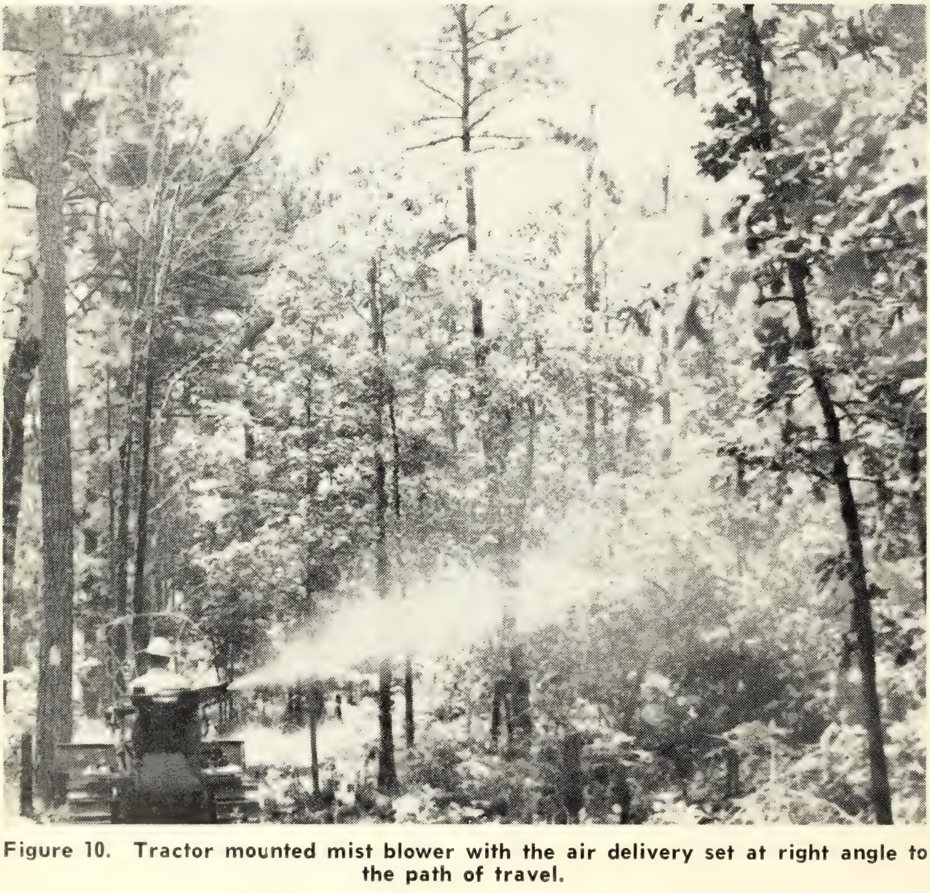


Figure 10. Tractor mounted mist blower with the air delivery set at right angle to the path of travel.

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An Economic Evaluation of
Production of Milk for Manufacturing
in Mississippi

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
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STATE COLLEGE MISSISSIPPI

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An Economic Evaluation of Production of Milk for Manufacturing in Mississippi

By J. G. HAMILL and J. H. SIMPSON, JR.

Supplies of milk for manufacturing have declined sharply in Mississippi in recent years. From a peak supply of over 368,000,000 pounds in 1957, the supply of milk had decreased 25.3 percent by the end of 1959. This rapid decline in supplies has created a problem of much concern to the manufactured milk industry. Some plants have been closed and other plants are operating at much below capacity due to insufficient supplies of milk for manufacturing.

For many years, milk for manufacturing in Mississippi has been furnished by a large number of small, usually diversified, farms. Some of the causes of a decrease in milk supplies from these small farms are: increased production costs, high beef prices, retirement of dairy farmers, new industries coming into predominately rural areas, and the relatively low price of milk for manufacturing in comparison to prices for grade A milk.

The Problem

Changing price - cost relationships along with the failure to adopt improved management practices have forced many farmers to discontinue their dairy operations. Future supplies of milk for manufacturing may depend upon the ability of producers to adopt improved management to combat the "price-cost squeeze" confronting them.

Objectives

The objectives of the study are:

1. To describe the present patterns of enterprise combinations and resource use found on the farms studied.
2. To describe a combination of enterprises giving the most profitable resource use under improved management.
3. To estimate net returns to the farm operation with present enterprise combinations and resource use.
4. To estimate net returns to the farm operation with the most profitable combination of enterprises using improved management with different levels of available family labor.

Scope and Method

In a 1959 farm survey, the Department of Agricultural Economics, Mississippi Agricultural Experiment Station, obtained estimates of the complete 1958 farm operation from 24 selected producers of milk for manufacturing. Managers and fieldmen of manufactured milk plants in Mississippi selected those producers who they felt represented the top 1 percent of all producers selling to their plants, and the sample of 24 producers was selected randomly from a listing of these "top" producers. Estimates of inputs and outputs for crop, livestock and pasture enterprises were obtained from each producer. Other data collected from each producer consisted of building and equipment inventories, available labor, and management practices. The information collected from this survey was used to construct a typical or average farm operation.

Two levels of management were considered in the analysis: (1) present management, that is, the level of management currently being exercised by the farmers interviewed in the study and (2) improved management, that is, a level of management which makes fuller use of known technology. Improved technology represents a combination of estimates from professional agricultural workers, farmer experience, and experimental results, as well as other published material.

In order to compare costs and returns under present and improved management, budgets for each alternative enterprise were constructed. Information from the farm survey was used in constructing enterprise budgets for the present management situation. Enterprise budgets under improved management were constructed using production techniques, and yield expectations as estimated by the sources indicated above. Average prices for 1958 were used in all of the budgets. Linear programming was used to determine the most profitable enterprise combination and resource use with three levels of available family labor. Production requirements, yields, costs, and returns for the typical farm under both levels of management were taken from the enterprise budgets.

DAIRY FARM MANAGEMENT

The successful operation of any business depends largely upon the capabilities of the manager. Careful culling, selective breeding, a good feeding program, and a good replacement program are essential functions of management in a strong and efficient dairy program. In this section, dairy and crop enterprise production practices followed under present management are compared with the alternative practices evaluated for the situations with improved management.

The practices evaluated under improved management compose an overall production program. Each practice is an essential part of the overall program. Omission of any part of the management program from the dairy operation could prevent achieving the level of production and the returns associated with improved management. However, practices other than those considered could be used provided they resulted in comparable returns.

The Dairy Herd

The average size of the dairy herd was about 23 animal units, with 19 cows milked during the year. The average annual production was 3,775 pounds of milk per cow. Under improved management, the average size of the dairy herd would vary from 39 animal units for a family of two to nearly 50 animal units for a family of four, Table 1. The assumed average annual production per cow under improved management, was 6,327 pounds, the average of 74 dairy herds on test in the Dairy Herd Improvement Association in Mississippi for 1958. By following the dairy management practice outlined in this study, dairy farmers can achieve this production per cow.

Culling and Breeding

A high producing herd can be developed only by an intensive program of culling and breeding. With an intensive program of culling, those cows which do not have the inherited characteristics for high milk production can be sold from the herd. Then with a well managed breeding program and/or purchase of high producing animals, replacements will have an increased genetic capability for milk production. Thus we have a never-ending problem of culling those that cannot produce and building the herd to a higher level of milk production.

The survey revealed that no records were kept on production per cow on the 24 farms studied. Hence, there was

Table 1. Size and composition of herd, present and optimum combination of resources, present and improved management, three levels of available labor, typical dairy farm, Mississippi, 1958.

Herd size	Family of 3		Improved management	
	Present management	Improved management	Family of 2	Family of 4
Cows	19.00	38.00	31.00	39.00
Heifers (1-2 years)	5.00	13.00	10.00	13.00
Heifers (under 1 year)	4.00	15.00	12.00	16.00
Bulls	1.00	0.0	0.0	0.0
Total number	29.00	66.00	53.00	68.00
Animal units*	23.50	48.25	39.00	49.50

*One mature cow; 2 heifers, 1-2 years; or 4 heifers under 1 year.

no sound basis for culling low producing cows. Under improved management, a record of production is a prerequisite for determining which cows to keep in the herd. This involves not only obtaining scales, weighing the milk, and keeping a record, but also using the record as a basis for culling.

Most of the farmers in the sample used their own or a neighbor's bull for breeding. The quality of breeding could not be measured, but the reasons for buying a particular bull ranged from the need for a cow-freshener to the desire to own a registered bull, with little consideration of his capabilities. No controlled breeding program was followed under present management; the study indicated that it was a common practice for the bull to be pastured with the herd.

Under improved management, mature cows would not be bred until the third heat period after calving, nor heifers until they attain the proper age and size, which vary with breed. All breeding would be done by artificial insemination. Artificial insemination, at an average fee of five dollars per cow, not only is generally more economical than is using a herd bull, but also has other advantages. It facilitates controlled breeding and the keeping of breeding records, both very important to an efficient dairy operation.

Raising Replacements

Under present management, about one heifer for each four cows was raised as a herd replacement. The housing for calves consisted of stalls in the barn, which had been used over and over, thus making sanitation quite a problem. Failure to sterilize utensils used in feeding intensified disease hazards. These factors, along with the breeding and culling practices followed under present management, made it almost impossible to raise herd replacements which would improve the herd.

Under improved management, all heifers would be raised. At least one heifer for each three cows would be retained as a replacemnt. Sterilizing all utensils used in feeding the calves and using portable pens for shelter would improve sanitation. Results of the calf management program followed at the Pontotoc-Ridge Flatwoods Branch Experiment Station, where seventy calves have been raised with no deaths or serious trouble from disease, evidence the value of these practices.[1]

Stored Roughage Program

On the 24 farms studied, hay was the only stored roughage. The average amount of hay harvested per farm was about 35 tons, of which about 26 tons were fed to dairy cattle. The average amount of hay fed per animal unit was 1.13 tons. Two major factors probably contributed to the low feeding-rate of hay. Either the hay was rationed, or if fed free-choice, it was of such poor quality that low consumption resulted. Probably a combination of these factors will more nearly fit the typical dairy farm; however, the survey revealed that feeding a rationed amount of hay was practiced on 19 of the farms.

Under improved management, 2½ tons of hay or hay-equivalent per animal unit would be needed each year and would be fed during those periods of the year when grazing would not provide for nutritional needs. Silage was considered to be an important factor in achieving the milk production set forth for improved management. Three tons of good quality silage were considered equivalent to one ton of good quality hay. Silage feeding would be limited to cows in production and fed at the rate of approximately 25 pounds per day when grazing was not available. Corn was the only silage crop considered under improved management.[2]

Since coastal bermuda is considered adaptable for most areas of Mississippi, it was the hay crop selected for use on the typical farm under improved management. Its use, of course, would depend on its adaptability in comparison with other crops for any particular farm situation. A high quality hay is a necessity under improved management and coastal bermuda will produce a high quality hay if managed properly. Hay would be fed free-choice to the entire herd during those periods when grazing is inadequate, preferably through some type of self-feeder.

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[1] Hurt, B. C., Jr., Graham, E. N., and Hamill, J. G., **Producing Milk for Manufacturing**, (Mississippi Agricultural Experiment Station Bulletin 590); State College, Mississippi, February 1960, pp 5-7.

[2] Research being conducted by the Department of Agronomy and Dairying, Mississippi Agricultural Experiment Station, shows promise for grain sorghums as a silage crop for dairy cattle.

Pasture Program

The typical pasture improvement program, under present management, consisted of seeding 1.5 acres of white clover, 1.0 acres of Dallis grass and 1.2 acres of of lespedeza on an annual basis. The average pasture acreage of 53.1 acres received an annual application of only 2.4 tons of fertilizer and lime, less than 100 pounds per acre. In an attempt to control weeds, all of the pasture land was clipped once. No temporary summer or winter grazing was provided.

Under improved management, an intensive pasture program was considered necessary to achieve the production goal of 6,327 pounds of milk per cow. The most important crops in this program are the coastal bermuda and crimson clover. This combination will produce the most grazing per acre of all permanent pasture crops considered. The crimson clover will furnish early spring grazing, and when the crimson clover is gone, two cuttings of hay from the coastal bermuda will furnish the necessary hay for the dairy operation with much additional grazing later. Cutting the coastal bermuda for hay twice would give adequate weed control.

The other permanent pasture crop included under improved management was a Dallis grass and white clover combination. For maximum grazing, the permanent pasture must be cross-fenced and a strict program of controlled grazing followed. Weeds would be controlled by spraying with 2, 4-D in June. Millet would be used in the summer as a temporary grazing crop, with half of the acreage being planted the first of May and the other half the first of June. This grazing would be utilized only by cows in production, and it would be control grazed.

Since land capabilities vary, the combination of pasture and forage crops used in this study will not be suitable for every farm situation. Soil-testing and other specialists of the Extension Service can assist the farmer in adjusting to his individual farm conditions.

Concentrate Feeding

On the typical farm, a concentrate mixture of oil-seed meal, corn, molasses, and salt, mixed to provide a 12.5 percent crude protein ration, was fed to the dairy herd at the rate of one pound of concentrate for each two pounds of milk.

The mix suggested for cows in production, under the improved level of management, is 265 pounds of oil-seed meal, 720 pounds of corn and cob meal and 15 pounds of salt. This mixture provides a 16 percent crude protein ration, which would be fed at the rate of about one pound of feed for each 3 pounds of milk during the winter months and 1 pound of feed for each 4 pounds of milk during the summer months. For winter feeding of dry cows and heifers, a mixture of 140 pounds of oil-seed meal, 850 pounds of corn and cob meal, and 10 pounds of salt provides an 11 percent crude protein ration. Dry cows would be fed approximately 5½ pounds of this mixture per day, large heifers about 4 pounds and small heifers about 5 pounds. This ration was developed primarily to utilize home-grown feeds in meeting the nutritional requirements of the dairy herd. The above feeding rates depend upon the availability of grazing.

LABOR, LAND AND CAPITAL

To maximize returns to any farm business, utilization of available resources must be such that a change in the use of a single unit of one of them would result in a decrease in total farm returns. In this study, the limiting resources were land and labor. Capital was not considered a limiting resource in this analysis. In this section, the farm organization and resource requirements under improved management with three levels of family labor are compared with the resource utilization under present management.

Labor

On the farms surveyed the family labor force averaged three persons. In no quarter of the year was family labor fully utilized, Table 2. Even though some labor for picking cotton was hired in the fall, on the average farm there was available during the year a total of 1,744 hours, or 174 ten-hour days, more family labor than was utilized.

Table 2 also shows the effect of the proposed farm reorganization upon the utilization of labor of a family of a size comparable to the sample average. Family labor was fully utilized during the first two quarters, with excess labor appearing mainly in the summer months. The same would be true for a family of two. For a family greater than three, available land would so limit the operation that much of the available family labor would not be utilized.

In estimating labor utilization, it was assumed that, within a given quarter, labor available for field work could be shifted to livestock but that livestock labor was not transferable to field labor.

Since hired labor was utilized for cotton under present management, it was

Table 2. Labor, amount available and utilized, by quarters, present and optimum combination of resources, present and improved management, three levels of available family labor, typical dairy farm, Mississippi, 1958.*

Labor	Family of 3				Improved management			
	Present management		Improved management		Family of 2		Family of 4	
	Available	Used	Available	Used	Available	Used	Available	Used
1st Quarter:								
Family labor	992	675	992	992	812	812	1,172	1,009
Field labor	(272)	(45)	(272)	(100)	(272)	(96)	(272)	(99)
Livestock labor	(720)	(630)	(720)	(892)	(540)	(716)	(900)	(910)
Total	992	675	992	992	812	812	1,172	1,009
2nd Quarter:								
Family labor	1,144	848	1,144	1,144	960	960	1,328	1,165
Field labor	(408)	(355)	(408)	(403)	(408)	(365)	408)	(408)
Livestock labor	(736)	(493)	(736)	(741)	(552)	(595)	(920)	(757)
Hired field labor	——	——	——	96	——	126	——	85
Total	1,144	848	1,144	1,240	960	1,086	1,328	1,250
3rd Quarter:								
Family labor	1,712	770	1,712	1,071	1,040	920	2,384	1,084
Field labor	(976)	(286)	(976)	(513)	(488)	(472)	(1,464)	(514)
Livestock labor	(736)	(484)	(736)	(558)	(552)	(448)	(920)	(570)
Total	1,712	770	1,712	1,071	1,040	920	2,384	1,084
4th Quarter:								
Family labor	1,176	987	1,176	1,082	994	957	1,358	1,095
Field labor	(448)	(435)	(448)	(448)	(448)	(448)	(448)	(448)
Livestock labor	(728)	(552)	(728)	(634)	(546)	(509)	(910)	(647)
Hired field labor	——	425	——	535	——	629	——	511
Total	1,176	1,412	1,176	1,617	994	1,586	1,358	1,606
Total annual	5,024	3,705	5,024	4,920	3,806	4,404	6,242	4,949

*Method of estimating available field labor:
Man—eight hours per day on days fit for field labor.
Child—eight hours per day on days fit for field labor during June, July, and August.

Method of estimating available livestock labor:
Man—two hours per day every day of the year.
Woman—four hours per day every day of the year.
Child—two hours per day every day of the year.

assumed that hired labor would also be available under improved management. The use of hired labor was restricted to that part of cotton chopping and picking which could not be done with family labor. Under conditions where hired labor was not available, cotton would not be included in the farm business under improved management. The 6.4 acres of cotton land would be utilized by the dairy enterprise, or for cash corn, or both, depending upon the best use of available family labor.

Land

The 24 farms in the survey averaged about 178 acres in size and contained, on the average, 113 acres of cropland and pasture (11 of which were idle), and 65 acres of woodland waste, Table 3. Existing land utilization, as well as that proposed is also shown in Table 3.

Cotton allotments on these farms averaged 6.4 acres. Since additional labor could be hired, the analysis indicated returns from cotton were higher than those from alternative uses, consequently, planting the full allotment in each of the situations considered in this analysis resulted in maximum returns. Diverting to other uses that acreage now devoted to hay crops also appeared more profitable in all situations. Hay requirements were produced from the coastal bermuda pasture.

In addition to the acreage in cotton and that required for support of the dairy herd, the smaller families would have other acreage available for cash crops. For three-member families there would be 2 acres, which could be utilized most profitably in the production of cash corn. Support of the smaller herds operated by families of two would require only about 84 acres, thus leaving nearly 23 acres available for other uses. However, unless additional labor were hired, only 12 acres of this excess land could be utilized for cash corn, and the remainder would be left idle for lack of labor. Four-member families would utilize all of their open land in support of the dairy operation and in the cotton enterprise.

Capital

Capital investment in the farm operation under present levels of management amounted to $27,044, Table 4.

Table 3. Land utilization, present and optimum combination of resources, present and improved management, three levels of available family labor, typical dairy farm, Mississippi, 1958.

Land utilization	Family of 3		Improved management	
	Present management	Improved management	Family of 2	Family of 4
	Acres			
Cotton	6.4	6.4	6.4	6.4
Corn for grain	23.7	20.8	27.1	19.2
Millet	0.0	19.3	15.5	19.6
Hay crops	18.9	0.0	0.0	0.0
Pasture	48.3	29.5	23.7	30.1
Pasture and hay	4.8	25.7	20.6	26.2
Corn for silage	0.0	11.6	9.3	11.8
Idle land	11.2	0.0	10.7	0.0
Woodland	60.8	60.8	60.8	60.8
Wasteland	4.4	4.4	4.4	4.4
Total	178.5	178.5	178.5	178.5

Table 4. Investment capital, present and optimum combination of resources, present and improved management, three levels of available family labor, typical dairy farm, Mississippi, 1958.

Investment	Family of 3		Improved management	
	Present management	Improved management	Family of 2	Family of 4
	Dollars			
Equipment	$ 5,617	$ 9,262	$ 9,262	$ 9,262
Buildings	3,134	3,901	3,901	3,901
Land	13,388	13,388	13,388	13,388
Fences	920	920	920	920
Cows	3,893	11,050	8,900	11,350
Pasture	92	141	114	144
Total	$27,044	$38,662	$36,485	$38,965

Additional investment capital would be required for each farm situation considered under improved management. Additional equipment and cows represent most of the additional investment capital needed under improved management. For an itemized listing see Appendix Table 12. This additional investment plays an important part in achieving the overall management program set forth in this study. In instances where the assets currently controlled by the farmers in the survey were not under mortgage, it is likely that the additional capital needed for each situation could be borrowed from existing credit agencies.

Analysis of the farm sample indicated that under present management, operating capital was borrowed. Therefore, a charge for interest on operating capital at an annual rate of 6.5 percent was made in each budget. Under improved management, the dairy enterprise furnished adequate operating capital during each quarterly accounting period and no interest charge was made in the budgets.

NET RETURNS TO THE FARM BUSINESS

Net returns to farm operators in the sample averaged $2,153 in 1958, Table 5. Cash receipts from the entire farm operation averaged $5,443 and expenses $3,290.

Adopting improved management practices would necessitate sharp increases in annual expenditures. For the average family of three, yearly expenses would be $6,713, a figure that is 104 percent above those incurred in 1958. But the change would result in substantial increases in output of both the dairy and cotton enterprises, and cash receipts would rise to an estimated $11,462, or 111 percent more than the former level. Thus, as a result of better management, improved labor utilization, and additional capital investment, net returns would be increased

Table 5. Returns to land, family labor, investment capital and management, present and optimum combination of resources, present and improved management, three levels of available family labor, typical dairy farm, Mississippi, 1958.

Item	Family of 3		Improved management	
	Present management	Improved management	Family of 2	Family of 4
	Dollars			
Receipts:				
Cotton	1,151	1,348	1,348	1,348
Corn	605	114	684	——
Hay	188	——	——	——
Milk	2,410	8,151	6,649	8,365
Cattle	1,089	1,849	1,509	1,898
Total	5,443	11,462	10,190	11,611
Expenses:				
Cotton	369	408	408	408
Corn	515	585	762	540
Hay crops	468	——	——	——
Pasture	144	480	386	490
Pasture and hay	*	796	638	812
Temporary grazing	——	247	199	251
Corn for silage	——	425	341	432
Feed purchased	437	1,507	1,229	1,546
Cattle purchased	480	——	——	——
Depreciation	144	226	184	232
Hauling milk and ADA	316	1,010	824	1,036
Hired labor**	155	230	275	218
Breeding	——	253	207	260
Miscellaneous***	262	546	445	560
Total	3,290	6,713	5,898	6,785
Total net returns to land, family labor, investment capital and management	2,153	4,749	4,292	4,826

*Pasture and hay costs are included in pasture costs.

**All hired labor used by the cotton enterprise.

***Miscellaneous includes cleaning materials, milking supplies, veterinary costs, electricity, repairs, etc.

to $4,749—a return 121 percent greater than that earned by the average sample farm in 1958. Net returns for farms operated by families of two and four would show similar increases.

Table 6 provides a complete summary of family labor, investment capital and net returns for the typical farm. Deducting a charge for investment other than land from total net returns shows the returns to land, labor and management. When a charge is made for land investment, the returns to family labor and management varied from $531 under present management to $2,422 under improved management for a family of three. Under the present system of management, the farm-family is getting an estimated $.66 net return per hour of family labor to land, labor, investment capital and management. By following improved management, it is possible to increase the net returns to land, labor, investment capital and management to $1.11 per hour for a family of three.

The farmer may be more interested in the returns he can expect from the additional labor, investment and management required to increase the size of his farm business to the level shown in this study as improved management. Table 7 shows the additional family labor used, investment, and net returns for different levels of available family labor. The additional net returns per hour to land, labor and management for each additional hour of family labor utilized after making a charge for additional investment ranges from $4.26 for a family of two to $1.82 for a family of four.

Table 6. Summary of family labor, investment capital and net returns, present and optimum combination of resources, present and improved management, three levels of available family labor, typical dairy farm, Mississippi, 1958.

Item	Unit	Family of 3		Improved management	
		Present management	Improved management	Family of 2	Family of 4
Family labor:					
Used	hrs.	3,280	4,289	3,649	4,353
Unused	hrs.	1,744	735	157	1,889
Total		5,024	5,024	3,806	6,242
Investment capital:					
Land	dol.	13,388	13,388	13,388	13,388
Other	dol.	13,656	25,274	23,097	25,577
Total		27,044	38,662	36,485	38,965
Interest on investment (6%):					
Land	dol.	803	803	803	803
Other	dol.	819	1,516	1,386	1,535
Total		1,622	2,319	2,189	2,338
Net returns:					
Land, labor, other capital and management	dol.	2,153	4,749	4,292	4,826
Land, labor and management	dol.	1,334	3,233	2,906	3,291
Labor and management	dol.	531	2,430	2,103	2,488
Net returns per hour of family labor:					
Land, labor, other capital and management	dol.	.66	1.11	1.18	1.11
Land, labor & management	dol.	.41	.75	.80	.76
Labor and management	dol.	.16	.57	.58	.57

Table 7. Summary of additional family labor, investment and net returns required in changing from present management to improved management, three levels of available family labor, typical dairy farm, Mississippi, 1958.

Item	Unit	Improved management		
		Family of 2	Family of 3	Family of 4
Additional family labor	hrs.	369	1,009	1,073
Additional investment	dol.	9,441	11,618	11,921
Interest on additional investment	dol.	566	697	715
Additional net returns to land, labor, investment capital and management	dol.	2,139	2,596	2,673
Additional net returns to land, labor and management	dol.	1,572	1,899	1,957
Additional returns per hour of additional family labor to land, labor, investment capital and management	dol.	5.80	2.57	2.49
Additional returns per hour of additional family labor to land, labor, and management	dol.	4.26	1.88	1.82

SUMMARY

Total farm production of milk for manufacturing has decreased during the past few years in response to changing price-cost relationships. Future supplies of milk for manufacturing will depend on the ability of producers to adjust their production practices to meet this "price-cost squeeze".

After making a farm survey of selected dairy producers, the basis for a typical farm conforming to the average of the group of farms studied was established. Present resource use and management showed a low level of utilization and management and consequently a very low return.

A consolidation of estimates from specialists in various related fields furnished the necessary information for constructing enterprise budgets to determine the costs and returns for different enterprises. The method of study involved the use of linear programming techniques which maximize returns to limited resources with land and available family labor being the limiting resources in this study. This resulted in different land, labor and capital utilization, all working together toward a higher net return.

Management of the dairy operation was given detailed consideration with improved practices being used in culling, breeding, feeding, and replacement programs. These practices were considered necessary to attain the desired level of production per cow.

Results of this analysis demonstrate that with more efficient utilization of land and labor, use of additional capital, and an improved management situation, the net returns to the farm business can be increased. These returns could be increased from $2,153 under present management to $4,749 under improved management for a family of three by increasing herd size, following a land-use pattern designed for support of the dairy, by utilizing an additional 1,009 hours of available family labor and an additional investment of $11,618.

The additional investment in dairy cattle and equipment was necessary to achieve the net returns obtained in this study. However, after making a charge for the additional investment, the additional net returns to the farm business for a family of three would be $1,899.

For a family of the same size the returns per hour to land, labor, investment capital and management would be increased from an estimated $.66 per hour under present management to $1.11 per hour under improved management.

APPENDIX TABLES

Appendix Table 1. Estimated costs and returns per cow, present and improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
Present Management (19-cow Milking Herd)				
Income:				
Milk	cwt.	37.75	$ 3.36	$126.84
Herd appreciation				32.07
Total				158.91
Expenses:				
Concentrate	cwt.	21.49	2.09	44.91
Calf starter	cwt.	.12	11.60	1.39
Pasture	acre	2.79	2.02	5.64
Hay	tons	1.39	22.52	31.30
Depreciation on fences, buildings and equipment				7.56
Hauling milk and ADA				16.61
Miscellaneous*				13.77
Total				121.18
Returns above specified expenses				$ 37.73
Improved Management (38-cow Milking Herd)				
Income:				
Milk	cwt.	63.27	$ 3.39	$214.49
Cattle sold				48.67
Total				263.16
Expenses:				
Concentrate	cwt.	23.58	2.05	48.34
Calf starter	cwt.	.98	11.60	11.37
Milk for calves	cwt.	2.26	3.39	7.66
Pasture	acre	.77	16.27	12.53
Pasture and hay	acre	.67	30.99	20.76
Temporary grazing	acre	.50	12.82	6.41
Corn for silage	acre	.30	36.63	10.99
Breeding				6.67
Depreciation on fences, buildings and equipment				5.94
Hauling milk and ADA				26.57
Miscellaneous*				14.36
Total				171.60
Net returns above specified expenses				$ 91.56

*Miscellaneous includes cleaning and other dairy supplies, veterinary costs, electricity, repairs, etc.

Appendix Table 2. CORN — Estimated costs and returns per acre, present and improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
Present Management				
Income:				
Corn	bu.	38.8	$ 1.14	$44.23
Expenses:				
Seed	bu.	.143	10.38	1.48
Ammonium nitrate	cwt.	1.79	3.80	6.80
Superphosphate	cwt.	1.44	1.55	2.23
Muriate of Potash	cwt.	.52	2.62	1.36
Tractor operation	hr.	8.0	.95	7.60
Equipment operation	ac.	1.0	—	1.79
Interest on operating capital				.49
Total expense				21.75
Returns above specified expenses				$22.48
Improved Management				
Income:				
Corn	bu.	50.0	$ 1.14	$57.00
Expenses:				
Seed	bu.	.2	10.38	2.08
Ammonium nitrate	cwt.	3.0	3.80	11.40
Superphosphate	cwt.	2.0	1.55	3.10
Muriate of Potash	cwt.	.5	2.62	1.31
Tractor operation	hr.	8.75	.95	8.31
Equipment operation	ac.	1.0	—	1.92
Total expense				28.12
Returns above specified expenses				$ 28.88

Appendix Table 3. COTTON — Estimated costs and returns per acre, present and improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
Present Management				
Income:				
Cotton lint	lb.	469.5	$ .3410	$160.10
Cottonseed*	lb.	829.2	.02385	19.78
Total				179.88
Expenses:				
Seed	cwt.	.75	11.50	8.62
Ammonium nitrate	cwt.	1.67	3.80	6.35
Superphosphate	cwt.	2.49	1.55	3.86
Muriate of Potash	cwt.	.95	2.62	2.49
Insecticides	ac.	1.0	—	6.77
Tractor operation	hr.	9.35	.95	8.88
Equipment operation	ac.	14.35	—	5.11
Ginning, bagging and ties	cwt.-lint	4.695	2.70	12.68
Miscellaneous	ac.	1.0	—	1.00
Interest on operating capital	ac.	1.0	—	1.82
Hired labor	ac.	1.0	—	24.24
Total expense				81.82
Returns above specified expenses				$ 98.06
Improved Management				
Income:				
Cotton lint	lb.	550.0	$ .3410	$187.55
Cottonseed**	lb.	971.1	.02385	23.16
Total				210.71
Expenses:				
Seed	cwt.	.75	11.50	8.62
Ammonium nitrate	cwt.	2.18	3.80	8.28
Superphosphate	cwt.	2.40	1.55	3.72
Muriate of potash	cwt.	.80	2.62	2.10
Insecticide	ac.	1.0	—	11.05
Tractor operation	hr.	9.35	.95	8.88
Equipment operation	ac.	1.0	—	5.21
Ginning, bagging and ties	cwt.-lint	5.50	2.70	14.85
Miscellaneous	ac.	1.0	—	1.00
Total expense				63.71
Returns above specified expenses***				$147.00

*Trash per bale = 3.3 percent of the harvested seed cotton weight (1,343 pounds), or 44.3 pounds of trash.

**Trash per bale = 3.3 percent of the harvested seed cotton weight (1,573 pounds), or 51.9 pounds of trash.

***No charge made for hired labor.

Appendix Table 4. WHITE CLOVER AND DALLIS GRASS PASTURE — Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Dallis grass seed*	lb.	1.0	.80	.80
White clover seed**	lb.	.2	.834	.17
Ammonium nitrate	cwt.	1.0	3.80	3.80
Superphosphate	cwt.	3.0	1.55	4.65
Muriate of potash	cwt.	1.0	2.62	2.62
Lime***	ton	.4	7.25	2.90
Tractor operation	hr.	1.2	.95	1.14
Equipment operation	ac.	1.0	—	.19
Total annual expense				16.27

*Pro-rated for 10-year life, 10 lbs. @ $.80/lb.

**Pro-rated for 10-year life, 2 lbs. @ $.834/lb.

***Two tons per acre every 5 years, custom application at $2/acre.

Appendix Table 5. COASTAL BERMUDA AND CRIMSON CLOVER FOR GRAZING AND HAY — Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Bermuda sprigs*	thous.	.25	.60	.15
Crimson clover **	lb.	6.0	.325	1.95
Ammonium nitrate	cwt.	2.0	3.80	7.60
Superphosphate	cwt.	3.0	1.55	4.65
Muriate of Potash	cwt.	1.33	2.62	3.48
Lime***	ton	.4	7.25	2.90
Tractor operation	hr.	7.04	.95	6.69
Equipment operation	ac.	1.0	—	3.57
Total annual expenses****				30.99

*Pro-rated over 20-year life, 5,000 sprigs at $.60/thousand.

**Pro-rated over 5-year life, 30 lbs. of seed at $32.50/cwt.

***Two tons per acre every 5 years, custom application at $2/acre.

****Includes cost of harvesting 2½ tons of hay per acre.

Appendix Table 6. MILLET — Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Seed	lb.	25.0	.09	2.25
Ammonium nitrate	cwt.	2.0	3.80	7.60
Tractor operation	hr.	2.5	.95	2.38
Equipment operation		1.0	—	.59
Total annual expense				12.82

Appendix Table 7. CORN SILAGE — Estimated annual costs per acre, improved management, typical dairy farm, Mississippi, 1958.

Item	Unit	Quantity	Price	Amount
			Dollars	Dollars
Expenses:				
Seed	bu.	.3	10.38	3.11
Ammonium nitrate	cwt.	3.0	3.80	11.40
Superphosphate	cwt.	2.0	1.55	3.10
Muriate of potash	cwt.	.5	2.62	1.31
Tractor operation	hr.	11.35	.95	10.78
Equipment operation	ac.	1.0	—	6.93
Total annual expenses*				36.63

*Includes cost of harvesting 9 tons per acre.

Appendix Table 8. Estimated quarterly labor requirements for farm operation, typical dairy farm, Mississippi, 1958.*

Operation	Hrs. 1st quarter	Hrs. 2nd quarter	Hrs. 3rd quarter	Hrs. 4th quarter	Total
Present Management (19-cow milking herd)					
Livestock labor (per cow):					
Feed hay	4.53	.47	—	.42	5.42
Feed, milk and clean-up	23.89	23.89	23.89	23.89	95.56
Miscellaneous	4.74	1.58	1.58	4.74	12.64
Total	33.16	25.94	25.47	29.05	113.62
Field labor (per acre):					
Permanent pasture	.08	.30	.43	.11	.92
Hay	—	2.49	3.02	—	5.51
Corn	1.35	5.82	2.83	10.72	20.72
Cotton	1.41	24.06	21.72	93.75	140.94
Total	2.84	32.67	28.00	104.58	168.09
Improved Management (38-cow milking herd)					
Livestock labor (per cow):					
Feed hay	1.53	.26	—	.50	2.29
Milk	11.47	12.42	8.97	8.21	41.07
Clean	1.55	1.61	1.61	1.58	6.35
Feed grain	1.42	1.55	1.13	1.03	5.13
Other routine work	1.21	1.24	1.24	1.24	4.93
Calves in pens	1.74	.97	.21	.97	3.89
Rotate grazing	—	24	.71	—	.95
Feed grinding	.61	.32	.21	.24	1.38
Fence repair	1.82	—	—	1.82	3.64
Feed silage	1.53	.26	—	.50	2.29
Miscellaneous	.61	.63	.61	.61	2.46
Total	23.49	19.50	14.69	16.70	74.38
Field labor (per acre):					
White clover and dallis grass	.24	.58	.98	.10	1.90
Coastal bermuda and crimson clover	1.56	4.09	5.14	.19	10.98
Millet	—	1.76	2.23	—	3.99
Corn silage	1.38	5.86	7.93	.26	15.43
Corn	1.35	5.82	2.84	15.24	25.25
Cotton	1.41	24.06	24.69	102.34	152.50
Total	5.94	42.17	43.81	118.13	210.05

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*First quarter—December, January, and February; second quarter—March, April, and May; third quarter—June, July and August; fourth quarter—September, October and November.

Appendix Table 9. Investment capital, present and optimum combination resources, present and improved management, typical dairy farm, Mississippi, 1958.

Item	Management	
	Present	Improved
	19-Cow Milking Herd	38-Cow Milking Herd
	Dollars	
Equipment:		
Tractor, 2-row	2,640	2,640
Breaking plow	325	—
Stalk-cutter, 2-row	—	500
Disk, 6' - 8'	485	485
Middlebreaker, 2-row	—	200
Fertilizer distributor, 10'	—	325
Fertilizer distributor, 2-row	75	75
Section harrow, 2-section	45	45
Cultivator, 2-row	285	285
Planter, 2-row	230	230
Trailer	465	465
Rake, side-delivery	—	485
Baler, small-PTO	—	1,750
Cultipacker, 10'	—	365
Spraying equipment	—	121
Cotton duster, hand	—	45
Mower, 7'	395	395
2-unit milking machine	260	260
Milk cooler, 7 can	220	220
Milk cans	117	221
Miscellaneous	75	150
Total	5,617	9,262
Buildings:		
Barn, hay storage and feeding	2 986	2,986
Milking barn	—	500
Trench silo	—	267
Other buildings	148	148
Total	3,134	3,901
Cattle:		
Milk cows	3,135	7,600
Heifers, (1-2 years)	450	1,950
Heifers, (under 1 year)	158	1,500
Bull	150	—
Total	3,893	11,050
Other:		
Land	13,388	13,388
Fences	920	920
Pasture	92	141
Total	14,400	14,449
Total investment	$27,044	$38,662

BULLETIN 614 APRIL, 1961

Fertility Practices
for
Cotton and Corn
in the
Yazoo-Mississippi Delta

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MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

Summary

Cotton.—

1. Differences in the effect of nitrogen sources on cotton yields were small.

2. Urea-ammonium nitrate solution was equal to anhydrous ammonia and ammonium nitrate for cotton.

3. Maximum yields of cotton were produced by nitrogen rates ranging from 90 to 120 pounds per acre.

4. Maximum earliness of cotton was obtained by using 60 pounds of nitrogen per acre.

5. Nitrogen applied before planting produced slightly higher yields than side dressing treatments.

6. Varying the placement distance from the drill had no effect on yields.

7. Nitrogen placed 8 to 14 inches deep resulted in higher yields than shallower application.

8. Nitrogen applied in the fall was less effective than spring-applied nitrogen.

9. Cotton responded to phosphorus in 7 of 48 tests when sites were selected at random and in 4 of 10 tests when locations were selected because soil tests indicated a probable response.

10. Cotton responded to potash in 9 of 48 tests when sites were selected at random and in 4 of 12 tests when locations were selected because soil tests indicated a probable response.

11. The application of lime increased the yield of cotton in 2 of 33 tests.

12. The application of magnesium did not affect cotton yields.

13. Cotton yields were not increased by minor elements .

14. There are areas in the Delta which are deficient in sulfur.

Corn.—

1. Differences in corn yields due to nitrogen sources were small.

2. Maximum corn yields resulted from 120 pounds of nitrogen per acre.

3. Pre-plant application of nitrogen produced slightly higher yields than side dressing.

4. Ammonium nitrate was more effective for side dressing corn than anhydrous ammonia when both were placed 6-7 inches deep.

5. Varying the distance of applying nitrogen from the drill had no effect on yields.

6. Corn yields increased as the depth of applying nitrogen increased to a 8-inch depth.

7. Corn yields were increased by phosphorus in 1 test in 31 tests at locations chosen at random.

8. In 31 tests at random sites potash did not affect yields.

9. In 22 tests lime had no effect on corn yields.

10. In 12 tests magnesium had no effect on yields.

FERTILITY PRACTICES FOR COTTON AND CORN IN THE YAZOO-MISSISSIPPI DELTA

By PERRIN GRISSOM And W. I. SPURGEON[1]

The work reported in this bulletin covers a period from 1949 through 1960. The experiments were designed to obtain data which would permit the revision of old recommendations and the development of new ones pertaining to the fertilization of cotton and corn.

In so far as possible, recommended cultural practices were employed in all of the experiments. The varieties planted were equal to or superior to the best on the recommended list. Insect control was practiced at a level consistent with, or more intense than, generally recommended. Land preparation, weed control, and cultivation were practiced in a conventional manner including the use of pre-emergence chemicals on cotton in the tests at the Delta Station beginning with 1956. In the experiments with cotton the plant population ranged from 3 to 5 stalks per hill spaced 14 to 20 inches apart, with row widths of 38 to 40 inches. In the corn experiments at the Experiment Station, plants were spaced one foot apart with rows 40 inches apart. In outlying tests a spacing between plants of 12 to 15 inches was attempted.

Cotton Fertilization

Sources of Nitrogen for Cotton

The experiment of longest duration which compared sources of nitrogen for cotton at the Delta Branch of the Mississippi Agricultural Experiment Station was started in 1921 and was concluded in 1957. The experiment was located on an area where Bosket silt loam predominated but where small areas of Dubbs silt loam were present. A rotation of cotton-oats-corn was practiced except in the first few years of the test. Each plot was treated with the same source of nitrogen regardless of which crop was being grown, The sources of nitrogen compared were sodium nitrate, ammonium nitrate, ammonium sulphate, cyanamid, cottonseed meal, and a mixture consisting of one-half cottonseed meal and one-half sodium nitrate. The rate of application was 30 pounds of nitrogen per acre through 1951.

In 1952 anhydrous ammonia was substituted for the mixture of cottonseed meal and nitrate of soda and the rate of nitrogen was changed to 90 pounds per acre for cotton. At the same time the rate of nitrogen was changed to 45 pounds per acre for oats and 120 pounds per acre for corn. Since the crops were rotated the rates on oats and corn have to be considered in interpreting the total effect of sources.

The variety of cotton changed several times during the experiment, however, no drastic changes in plant type or yielding ability occurred between any two years although there was a gradual shift to better varieties. The planting date varied with weather conditions but in 3 out of each 4 years the cotton was planted between May 1 and May 10.

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Table 1. **Effect of sources of nitrogen on the yield of cotton, Delta Station.**

Treatment	1921-1951 average	1952-1957 average	37-Year average
	Pounds of seed cotton per acre		
No nitrogen	1094	1002	1079
Sodium nitrate	1633	2031	1698
Ammonium nitrate	1634	2115	1712
Ammonium sulphate	1578	2124	1667
Cyanamid	1571	2055	1649
Cotton seed meal	1505	1531	1509
One-half cotton seed meal and one-half sodium nitrate	1539	....	....
Anhydrous ammonia	....	2135	....

Soil type—Bosket silt loam predominates with small areas of Dubbs included.
Rate of nitrogen—30 pounds per acre 1921 through 1951.
90 pounds per acre 1952 through 1957.
Time of application—one to three weeks before planting.

The 37-year results (*Table 1.*) show only small differences between nitrogen sources, except the yield from cottonseed meal was lower than from other materials.

The influence of a nitrogen source on soil acidity is an important consideration that may affect its efficiency. No records are available indicating the pH of the soil at the beginning of the experiment described above. In 1942 the ammonium sulphate plots had a pH of 6.30, the check plots had a pH of 6.70, and the plots treated with nitrate of soda had a pH of 7.0. At the conclusion of the experiment a total of 1440 pounds of nitrogen per acre had been applied. Of this amount, 810 pounds of nitrogen were applied in the last 16 years. In 1957, the ammonium sulphate plots had an average pH of 5.87, the check plots had a pH of 6.30, the nitrate of soda plots were 6.74. Although the ammonium sulphate plots had increased in acidity more than other treatments the acidity had not increased enough to affect yields.

There have been numerous additional tests which compared nitrogen sources. Some of the results of other tests were reported in Mississippi Agricultural Experiment Station Bulletin 473 published in 1950. Several of these experiments compared nitrogen sources at different rates. The highest rate of application was 60 pounds of N per acre.

In one test described in Bulletin 473, located at the Delta Station the original rates were 30, 45, and 60 pounds of N per acre. In 1951 the rates were changed to 30, 60, and 90 pounds per acre with the 90-pound rate substituted for 45 pounds. In 1954 a 120-pound rate was substituted for the 30-pound rate. When sources of nitrogen were compared at different rates for the 5-year period 1955-1959, the average yields show no significant difference between sources. (*Table 2*) There were indications of differences, although not statistically significant, within individual years. Soil variation accounted for some of the yield variations. Cyanamid was included in the experiment originally but was eliminated because of the toxic effect of the 120-pound rate on young plants.

Urea was tested as a source of nitrogen in the Delta 20 to 30 years ago and generally proved equal or almost equal to other nitrogen sources. In view of the increased production of urea in recent years it appeared desirable to collect current data on the efficiency of urea. A test was initiated in 1954 to compare urea with anhydrous ammonia and ammonium nitrate at 3 rates of application. The results (*Table 3*) show no significant differences among sources and in-

Table 2. Average yield of cotton for 5-year period with different sources of nitrogen when applied at different rates, Delta Station, 1955-59.

Nitrogen source	60 pounds of N per acre	90 pounds of N per acre	120 pounds of N per acre
	Pounds of seed cotton per acre		
No nitrogen	1794	1814	1791
Ammonium nitrate	2510	2505	2655
Ammonium sulphate	2448	2477	2641
Anhydrous ammonia	2406	2514	2600
Sodium nitrate	2370	2526	2563

Soil type—Bosket silt loams.
Time of application—Preplant.

Table 3. Urea compared with anhydrous ammonia and ammonium nitrate as a source of nitrogen for cotton, Delta Station.

Nitrogen source	1954	1955	1956	1957	1958	Average
No treatment	1648	2076	1369	1588	1663	1669
Urea	1854	2937	1993	2084	2908	2355
Ammonium nitrate	1910	2992	2024	2063	2981	2394
Anhydrous ammonia	1881	3014	2043	2030	2903	2374

Soil type—Bosket loam
Rate of nitrogen—Each yield figure represents an average of plots receiving treatments at the rate of 60, 90, and 120 pounds of N per acre.
Time of application—3 to 8 days before planting.
Depth of application—6 to 8 inches deep.

Table 4. Urea-ammonium nitrate solution compared with ammonium nitrate for cotton production, Delta Station.

	Preplant application				Sidedressing application			
Treatment	1957	1959	1960	3-Yr. avg.	1957	1959	1960	3-Yr. avg.
	Pounds of seed cotton per acre							
No treatment	1350	1740	2299	1796	....	2010	1777	....
Ammonium nitrate, surface	2088	2388	2715	2397	1666	2568	1955	2063
Urea-ammonium nitrate, surface	2095	2373	2629	2366	1712	2588	1810	2037
Ammonium nitrate, 6" deep	2164	2628	2765	2519	1677	2645	1908	2077
Urea-ammonium nitrate, 6" deep	2113	2697	2513	2441	1542	2564	1739	1948

Soil type—Bosket silt loam.
Rates of application—60 pounds of nitrogen per acre.
Time of application—preplant - 3-10 days before planting.
sidedressing - when cotton was 5-7 weeks old.
1958 results discarded because of suggestion of faulty application equipment.

dicate urea to be equal to anhydrous ammonia and ammonium nitrate for cotton when applied in the soil.

In 1957 tests were started to collect data comparing non-pressure nitrogen solutions with other nitrogen sources. Previous work at this Station in 1942 and 1943 indicated that non-pressure nitrogen solutions and those with very low pressure containing some free ammonia were satisfactory sources of nitrogen. In the recent tests a urea-ammonium nitrate solution containing 32 percent nitrogen has been compared with injection into trate. Surface applications have been compared with injection into the soil.

Results (*Table 4*) show only slight differences between ammonium nitrate and urea-ammonium nitrate. Both materials were slightly more effective when applied 6" deep than when applied on the

Table 5. The influence of rates of nitrogen on the yield of cotton, Delta Branch Experiment Station, 1921-1957.

Year	No nitrogen	Pounds of nitrogen per acre					
		7.5	15.0	22.5	30.0	37.5	45.0
		Yields in pounds of seed cotton per acre					
1921	1384	1461	1562	1702	1723	1803	1705
1922	733	834	902	967	972	1008	1083
1923	457	622	768	879	991	958	874
1924	1168	1190	1198	1309	1369	1470	1456
1925	2604	3060	2965	3020	2903	3010	3050
1926	2074	2216	2362	2554	2863	3112	3102
1927	1315	1503	1657	1927	2704	2780	2790
1928	1628	1838	1959	2023	2201	2313	2390
1929	1382	1543	1663	1820	2038	2127	2257
1930	801	853	893	1115	1113	1136	1149
1931	1189	1326	1410	1444	1411	1556	1542
1932	645	711	828	889	963	1012	1052
1933	886	973	1091	1235	1493	1542	1656
1934	778	854	939	964	1012	1036	1075
1935	1048	1179	1207	1370	1434	1599	1651
1936	777	840	999	1082	1169	1085	1121
1937	902	1106	1257	1452	1620	1765	1798
1938	1167	1275	1417	1681	1781	1931	1999
1939	961	1036	1210	1244	1556	1545	1540
1940	949	1080	1252	1444	1549	1575	1586
1941	1104	1220	1435	1654	1875	2079	2236
1942	886	956	1198	1455	1487	1581	1794
1943	945	1045	1127	1247	1357	1421	1456
1944	836	923	1061	1284	1498	1437	1508
1945	654	869	1060	1424	1539	1763	1753
1946	736	817	1065	1116	1160	1331	1508
1947	903	1313	1168	1285	1577	1674	1868
1948	866	981	1163	1436	1610	1880	1917
1949	874	965	1134	1243	1419	1515	1585
1950	557	774	896	921	1035	1126	1076
1951	678	687	816	921	1042	1079	1127
1952	840	758	944	1050	1315	1468	1563
1953	1151	1253	1658	1785	1945	2086	2156
1954	995	1067	1267	1318	1415	1377	1384
1955	1194	1161	1382	1583	1825	2122	2399
1956	686	729	797	914	1161	1245	1237
1957	1088	1582	1642	1682	1740	1759	1977
Avg.	1023	1151	1280	1418	1564	1657	1714

Soil type—Bosket silt loam
Source of nitrogen—Sodium nitrate

surface before planting. Placement had no effect on sidedressing application. Failure to show a difference because of placement may have been due to the relatively low response to nitrogen.

Rates of Nitrogen for Cotton

The nitrogen rates test of longest duration at the Delta Station was begun in 1921 and was continued through 1957. This test was conducted in a manner similar to the long-time sources test described earlier. Cotton, corn, and oats were rotated but the nitrogen rates remained the same on each plot regardless which crop was being grown. Nitrate of soda was used as the source of nitrogen and was applied before planting. These results show an increase in yield of cotton as the rate of nitrogen increased. (*Table 5*) The degree of increase varied with years.

Mississippi Agricultural Experiment Station Bulletin 473 listed results with other nitrogen rates experiments, although only one test was reported where rates exceeded 75 pounds of nitrogen per acre. Several tests have been conducted in recent years where higher rates have been compared. Table 6 lists the annual yields of cotton where rates of nitrogen range from 45 pounds per acre to 150 pounds per acre. In this experiment one-half of each plot was treated with early applications of insecticide for control of thrips. Except in 1950 the thrips control did not affect yield or earliness of cotton. Therefore, each yield figure represents an average of treated and untreat-

Table 6. Effect of rates of nitrogen on cotton production at Delta Station, 1950-1958.

Pounds N/A	1950	1951	1952	1953	1954	1955	1956	1957	1958	Avg.	Increase over check
					Pounds of seed cotton per acre						
0	1241	1100	1524	1910	1005	1960	1314	1625	1837	1502	......
45	1776	1626	1928	2357	1476	2652	1611	2130	2290	1983	481
60	1806	1607	2014	2541	1412	2925	1830	2087	2413	2071	569
75	1874	1611	2152	2691	1411	2955	1810	2140	2470	2124	622
90	1711	1620	2152	2670	1484	3000	1810	2228	2754	2159	657
105	1500	1540	2147	2771	1476	3015	1852	2033	2709	2166	614
150	1001	1475	2177	2826	1543	2928	1749	1912	2733	2038	536

Soil type—Bosket - Dubbs silt loam complex.
Nitrogen source—anhydrous ammonia.
Time of application—one to three weeks before planting.

Table 7. Effect of rates of nitrogen on cotton production at Delta Station, 1951-1956.

Pounds N/A	1951	1952	1953	1954	1955	1956	6-Yr. avg.	Increase over check
				Pounds of seed cotton per acre				
0	700	870	1360	1074	1001	743	958	......
45	1098	1771	2329	1202	2005	1523	1655	697
60	1290	2091	2544	1224	2339	1685	1862	904
75	1431	2258	2795	1403	2347	1868	2017	1059
90	1423	2369	2759	1374	2429	1850	2034	1076
105	1470	2407	2874	1601	2638	2006	2166	1208
120	1447	2540	2962	1523	2701	2014	2198	1240

Soil type—Bosket silt loam.
Source of nitrogen—Anhydrous ammonia.
Time of application—one to three weeks before planting.

ed with respect to early insects. The response to nitrogen was somewhat low and the highest average yields were obtained with 90 pounds of nitrogen per acre. However, there were no significant differences among 75, 90, and 105 pounds of nitrogen per acre. The yield of cotton was reduced by applying 150 pounds of nitrogen per acre.

In a nitrogen rates test which ran for 6 years, (*Table 7*) the highest yield was obtained with 120 pounds of nitrogen per acre but there were only 32 pounds of seed cotton per acre more than on the 105 pound rate.

Table 8. Summary by years of rates of nitrogen influence on seed cotton yields in dual objective experiments, Delta Station.

Sources & Rates Test

Pounds of N/A	1951	1952	1953	Avg.
0	1187	1836	2004	1676
30	1411	1972	2472	1952
60	1751	2388	2525	2221
90	1713	2234	2730	2226

Sources & Rates Test

Pounds of N/A	1954	1955	1956	1957	1958	1959	1960	Avg.
0	1397	2057	1430	1717	1887	1906	2040	1777
60	1698	2861	1943	1986	2762	2614	2568	2347
90	1565	2876	2025	2060	2745	2859	2480	2373
120	1513	2948	1891	2133	3087	3019	2720	2473

NPK Test

Pounds of N/A	1951	1952	1953	Avg.
30	1422	1634	2065	1707
60	1610	1854	2307	1924

NPK Test

Pounds of N/A	1954	1955	1956	1957	1958	1959	1960	Avg.
60	1960	2869	1534	2304	2492	2684	2314	2308
90	1726	3036	1689	2279	3053	3032	2418	2462
120	1763	3130	1642	2333	3086	3137	2447	2505

Urea Versus Other Sources

Pounds of N/A	1954	1955	1956	1957	1958	Avg.
0	1648	2076	1369	1588	1663	1669
60	1826	2913	1824	2290	2732	2317
90	2008	3027	2142	2084	3007	2454
120	1812	3003	2051	1804	3052	2344

Rates of Nitrogen & Irrigation

Pounds of N/A	1952	1953	1954	3-Yr. av.	1955	1956	1958	3-Yr. Avg.
60	2317	2639	2224	2393	....	....	....	....
90	2465	2813	2481	2586	2702	1589	2490	2260
120	2727	3080	2321	2709	2665	1763	2474	2301
150	....	....	....	....	2585	1840	2347	2257

Results of several experiments in which rates of nitrogen were varied in conjunction with other variables, (*Table 8*) show that highest yields were obtained with 90 or 120 pounds of nitrogen per acre. In most cases the difference between the two rates was not significant.

A test was initiated in 1954 to study the effect of extremely high rates of nitrogen on cotton production. The 7- year results of this experiment (*Table 9*) show application of 120 pounds of nitrogen per acre resulted in the highest average yield. The average yield of the untreated plot was higher than normally would be expected and it is possible that some movement of nitrogen occurred from the treated plots. A point of interest in connection with this test was that considerable lodging occurred in some years when the rate of application exceeded 180 pounds per acre.

The influence of rates of nitrogen on earliness of cotton is an important consideration which might influence the economy of higher rates of application. Most of the experiments which are described in this bulletin were picked twice. However, in some years a major portion of the cotton was open at the first picking. In an attempt to make some appraisal of the effect of nitrogen rates on earliness of cotton the amount of cotton harvested at the first picking, where less than two-thirds of the total crop was open, is used. Although, the results are not as consistent as would be desired, the application of 60 pounds of nitrogen per acre resulted in the largest amount of cotton harvested at the first picking (*Table 10*). With one exception rates of nitrogen above 60 pounds per acre reduced the amount of cotton at first harvest.

Time of Applying Nitrogen

Previous work has shown highest yields have usually been produced by applying nitrogen near planting time. Sidedressing usually resulted in slightly lower yields than preplanting application. An experiment was begun in 1950 to study the influence of rate of nitrogen on the response of cotton to time of application. In this experiment the original rates were 30, 45, 60, and 75 pounds of nitrogen per acre. In 1955 a 90-pound rate was substituted for the 30-pound rate.

At the lower rates of nitrogen there appeared to be a slight advantage for applying the nitrogen

Table 9. Rates of nitrogen for cotton production.

Pounds N/acre	1954	1955	1956	1957	1958	1959	1960	7-Year average
			Pounds of seed cotton per acre					
0	1584	1963	1449	1942	2129	1975	2012	1865
60	1774	2765	1762	2278	2611	2732	2293	2316
120	1929	2848	1774	2614	3136	2970	2546	2545
180	1833	2911	1766	2243	3053	2961	2427	2456
240	1711	2807	1937	1839	2952	2902	2626	2396
300	1616	2697	1822	1981	2807	2590	2552	2295
360	1774	2715	1897	2308	2721	2409	2664	2355

Soil type—Dubbs silt loam.
Source of nitrogen—Anhydrous ammonia.
Time of application—Prior to planting.

Table 10. **Effect of rates of nitrogen on the amount of cotton harvested at first picking in 6 experiments.**

Pounds of N. per A	Test 1 4-yr. av.	Test 2 2-yr. av.	Test 3 2-yr. av.	Test 4 4-yr. av.	Test 5 3-yr. av.	Test 6 3-yr. av.
	Pounds of seed cotton per acre					
0	1015	....	915	992	1080	673
45	1469	....	....	1252	....	1064
60	1522	1589	1223	1198	1451	1058
90	1483	1503	973	1111	1326	1219
120	....	1385	782	....	1266	1207
150	....	....	....	874	....	....

Test 1—Rates & time of applying ammonia, 1952, 1955, 1956, and 1958.
Test 2—NPK, 1955 and 1958.
Test 3—Urea compared with ammonia and ammonium nitrate 1955 and 1958.
Test 4—Rates of N - - - - 1950, 1951, 1955, and 1958
Test 5—Sources and rates of nitrogen - 1955, 1956, and 1958.
Test 6—Rates of N - - - - 1951, 1952, and 1953

as a split application or as a sidedressing, (*Table 11*). As the rate of nitrogen increased the preplanting application gained an advantage. The highest yields produced in the experiment were when the highest rate of nitrogen was applied before planting.

A question frequently arises as to how late nitrogen may be applied with beneficial results. Previous work has shown July nitrogen applications relatively inefficient but has shown some benefit. Late sidedressing has been doubtful. Four year's sidedressing with ammonium nitrate at the rate of 30 pounds of N per acre during the last weeks of July or the first week of August gave positive results in only one year. In 1957 nitrogen applied August 6 increased the yield of cotton 300 pounds of seed cotton per acre. Observations suggest the beneficial results one year in four from late sidedressing may be even greater than can normally be expected.

A series of experiments was started in 1955 to compare fall application of nitrogen for cotton with spring-applied nitrogen. Previous work had shown considerable variation in the response of cotton to fall-applied nitrogen. Bulletin 473, referred to earlier, reports the 13-year results of one test where fall-applied nitrogen was almost equal to spring-applied nitrogen. Other tests have produced different results. Anhydrous ammonia applied in December of 1952 resulted in a yield of 2469 pounds of seed cotton per acre while a May application produced 2721 pounds per acre.

In the experiments begun in 1955 three sources of nitrogen were used and applied at the rates of 60 and 120 pounds per acre. Tests were located at 8 sites. At 3 of the locations there was no response to nitrogen indicating a high carryover from the previous crop. The yield obtained in the responsive tests are shown in Table 12. Since the fall of 1955, weather conditions and other factors have prevented as many tests as in 1955-56. Tests were conducted at two places in 1957 and at two places in 1960. The yields in these tests are also reported in Table 12. When all of the cotton yields are averaged there is a consistent advantage for spring-applied nitrogen. However, at 3 of the 5 locations in 1955 there were no significant differences due

Table 11. Rates and time of applying nitrogen for cotton, Delta Station. 1950-1958.

Pounds N per acre	Time of application	1950	1951	1952	1953	4-Yr. avg.	1955	1956	1957	1958	4-Yr. avg.	8-Yr. avg.
		Pounds of seed cotton per acre										
....	No treatment	1518	1096	1417	1827	1465	1574	1099	945	1562	1295	1380
30	Preplant	1895	1318	1764	1963	1735	....	....	....	....	....	....
30	1/2 Preplant - 1/2 Sidedress	1916	1361	1732	2204	1803	....	....	....	....	....	....
30	Side dress	2046	1488	1913	2228	1919	....	....	....	....	....	....
45	Preplant	1948	1612	1919	2198	1919	2738	1696	1747	2242	2106	2013
45	1/2 Preplant - 1/2 Sidedress	2082	1565	1999	2358	2001	2536	1723	1588	2052	1975	1988
45	Side dress	2073	1543	2017	2519	2038	2426	1749	1431	2135	1935	1987
60	Preplant	2043	1706	1948	2331	2007	2723	1883	1920	2465	2248	2128
60	1/2 Preplant - 1/2 Sidedress	2225	1615	2026	2530	2099	2726	1883	1860	2355	2206	2153
60	Side dress	2002	1623	1949	2519	2023	2468	1951	1607	1382	2102	2063
75	Preplant	2124	1677	2061	2519	2095	2774	1945	2025	2590	2334	2215
75	1/2 Preplant - 1/2 Sidedress	2088	1673	2070	2548	2095	2667	1889	1782	2726	2266	2181
75	Side dress	1779	1601	2037	2673	2023	2539	1978	1823	2691	2258	2141
90	Preplant	....	....	....	....	....	2839	2094	1679	2786	2350	....
90	1/2 Preplant - 1/2 Sidedress	....	....	....	....	....	2711	2052	1623	2729	2279	....
90	Side dress	....	....	....	....	....	2443	2100	1401	2700	2161	....

Soil type—Dubbs and Bosket silt loam.
Nitrogen source—Anhydrous ammonia.

Table 12. Fall versus spring application of nitrogen for cotton production on different soil types.

Pounds of N per acre	Source	Time of application	Soil type and years S-424 1956	S-322 1956	S-436 1956	S-436 1957	W-322 1956	W-322 1960	W-456 1956	W-456 1957	W-456[1] 1960	Years & soil types avg.
			Pounds of seed cotton per acre									
No nitrogen			1061	914	1858	1215	1184	1451	939	563	1822	1223
60	Nitrate of soda	Fall	1283	1377	2033	1789	1326	2050	1319	1007	2317	1611
60	Nitrate of soda	Spring	1192	1319	1925	2045	1421	2331	1446	1926	2736	1816
60	Ammonium nitrate	Fall	1341	1388	1963	1856	1442	1862	1194	1355	2472	1653
60	Ammonium nitrate	Spring	1282	1422	2007	1956	1450	2305	1393	1700	2614	1792
60	Anhydrous ammonia	Fall	1325	1249	2079	1721	1445*	1812	1348	1744	2433	1684
60	Anhydrous ammonia	Spring	1265	1298	2074	1951	1514*	2204	1268	2419	2507	1833
120	Nitrate of soda	Fall	1333	1728	2045	1755	1677	2156	1562	1306	2810	1819
120	Nitrate of soda	Spring	1298	1611	2049	1985	1766	2774	1547	1801	3371	2022
120	Ammonium nitrate	Fall	1350	1649	1974	1843	1623	2261	1509	1058	3190	1829
120	Ammonium nitrate	Spring	1249	1663	1933	1883	1620	2579	1476	1651	3436	1943
120	Anhydrous ammonia	Fall	1304	1510	1940	1769	1579*	1967	1595	1398	2991	1784
120	Anhydrous ammonia	Spring	1243	1627	1953	2025	1767*	2223	1598	1869	3451	1974

* Cyanamid used in place of anhydrous ammonia.

[1] Soil types: 424—Forestdale silty clay loams.
322—Sharkey clay.
436—Dundee fine sandy loam.
456—Bosket fine sandy loam.

to time of application. At one location there was an advantage for fall-applied nitrogen and on one site, W-322, a slight advantage for spring applied nitrogen. It should be pointed out that precipitation was below normal during the winter of 1955-56. In 1957 both tests showed an advantage for spring-applied nitrogen. The inefficiency of fall-applied nitrogen for the 1957 crop was attributed to heavy weed growth on location S-436. On location W-322 the nitrogen was apparently lost by other means. The 1960 results were similar to those obtained in 1957. These results show spring application of nitrogen was better than fall application. Winter weeds on the lighter soils and loss, possibly due to denitrification, on the heavy soils appear to be the main reasons for the advantage for spring application.

Regardless of what accounts for the reduced efficiency of nitrogen applied in the fall, the results indicate the practice is not satisfactory.

Placement of Nitrogen

The 5-year results showing the influence of placement of nitrogen, at varying distances from the drill, on the yield of cotton are reported in Table 13. The average yields show no differences occurred as a result of the placement treatments. There were plant responses which conceivably could affect yields under different soil or weather conditions. When the nitrogen was placed 20 inches from the drill there was a lag averaging 5 to 6 weeks before the cotton plants picked up the applied nitrogen. When the nitrogen was placed 13 inches from the drill the lag amounted to about 3 to 4 weeks after planting. There was no difference in the effect of anhydrous ammonia and ammonium nitrate on yields or the response to placement. Therefore, the yields were reported as averages of the two sources.

The 6-year results of a test which evaluated depth of placement of nitrogen are reported in Table 14. In this experiment the depth of placement was measured from level ground. The yields show an increase as the nitrogen application became deeper. There was no difference between anhydrous am-

Table 13. Influence of placement of nitrogen at varying distances from the drill on the yield of cotton.

Placement	1949	1950	1951	1952	1953	Average
		Pounds of seed cotton per acre				
No treatment	1381	1482	1092	1485	1605	1409
Directly beneath seed	2038	1938	1609	1948	2410	1989
6 inches to one side of seed drill	2042	2033	1738	2057	2462	2066
In two bands 6 inches from seed drill	2008	2048	1597	1985	2371	2002
13 inches from seed drill	1998	2105	1603	2051	2379	2027
20 inches from seed drill	2012	2027	1567	1988	2327	1984

Soil type—Dubbs silt loam.
Nitrogen source—Each yield figure is an average of plots receiving anhydrous ammonia and ammonium nitrate.
Rate of nitrogen—60 pounds of N per acre.
Depth of placement—6 to 9 inches deep.
Time of application—one to three weeks before planting.

Table 14. Effect of depth of placement of nitrogen on the yield of cotton.

Depth of placement	1949	1950	1951	1952	1953	1954	Avg.
	Pounds of seed cotton per acre						
No treatment	1464	1601	1206	1586	1795	1259	1485
4 inches	2128	1856	1550	2084	2373	1337	1888
6 inches	2209	2002	1580	2229	2408	1315	1957
8 inches	2333	2086	1585	2231	2464	1435	2022
10 inches	2336	2084	1739	2239	2583	1444	2071

Soil type—Bosket loam.
Rate of nitrogen—60 pounds of N per acre.
Source of nitrogen—Each yield figure is an average of anhydrous ammonia and ammonium nitrate treated plots.
Time of application—Before planting.

monia and ammonium nitrate in their effect on yields. Again the yields from sources were averaged for reporting purposes.

In this experiment it could not be determined whether the response to depth of application was due entirely to the placement of nitrogen or whether some of the increased yields may have been attributable to the effect of the chisel used in making the deep application. In an attempt to eliminate the effect of the chisel another experiment was initiated in 1955. In this experiment the nitrogen was applied at 10, 14, and 18 inches deep and companion plots were treated at the same depth with the chisel but the nitrogen application was made 2 to 3 inches deep. The results(*Table 15*) indicate some advantage for placing nitrogen 10 to 14 inches deep and the response is not attributable to the effect of the chisel.

Phosphorus and Potash for Cotton

Prior to 1949 several experiments were conducted at the Delta Station and on outlying fields where the influence of phosphorus and potash on cotton production was measured. Most of these experiments showed no benefit. However, there were some exceptions. Most of these experiments were also conducted on the best soils of the Delta. In 1949 a testing program was initiated to study the response to phosphorus and potash on a cross section of Delta soils. Mississippi Agricultural Experiment Station survey personnel and the Mississippi Agricultural Extension Service cooperated in this project. Table 16 reports the results of most of these tests. Several experiments were abandoned and the data from others were discarded because of extreme experimental error. The soil types have been divided into 5 groups based on similar physical characteristics. The yields are reported on 17 locations on Dundee soils. These varied from very fine sandy loam to silty clay loam. There were 7 of the tests areas where significant response or a strong indication of significant response to phosphorus and/or potash was measured. There were 10 locations where no significant response was measured. On the 10 locations the highest rate of phosphorus and potash produced slightly higher actual yields than the average of the other treatments.

There was considerable variation in yield on the Collins soil and the response to nitrogen was low. Two of the 4 locations produced higher yields when phosphor-

Table 15. Effect of varying depth of applying of nitrogen on cotton yields, Delta Station, 1955-1960.

Treatment	1955	1956	1957	1958	1959	1960	6-Yr. avg.
	Pounds of seed cotton per acre						
No treatment	2070	1228	1561	1530	1188	1329	1484
Subsoiled, 10 inches—no nitrogen	2037	1457	1733	1556	1161	1629	1596
Subsoiled, 14 inches—no nitrogen	1928	1497	1312	1741	1230	1498	1534
Subsoiled, 18 inches—no nitrogen	1877	1529	1269	1500	1164	1430	1462
No subsoiling, nitrogen surface applied	2301	1671	2300	2302	2652	2003	2205
Subsoiled 10 inches, nitrogen surface applied	2634	1639	2338	2400	2718	1875	2267
Subsoiled 14 inches, nitrogen surface applied	2893	1853	1701	2305	3047	2163	2327
Subsoiled 18 inches, nitrogen surface applied	2614	1750	1679	2070	2674	2157	2158
Subsoiled 10 inches nitrogen 10 inches deep	2759	1790	2327	2560	2819	1825	2347
Subsoiled 14 inches nitrogen 14 inches deep	2869	1845	1809	2703	2920	2059	2368
Subsoiled 18 inches nitrogen 18 inches deep	2747	1881	1717	2501	2824	1875	2258

Soil type—Dubbs silt loam.
Nitrogen source—Ammonium nitrate.
Rate of nitrogen—60 pounds of N per acre.

us and potash were applied at the 80-pound level.

There was no response to phosphorus or potash on Bosket, Dubbs, Sharkey, Alligator, Forestdale, and Brittain soils.

The data reported in Table 16 gives some indication of productive capacity of various Delta soils. Highest yields were obtained with the better drained Bosket and Dubbs soil and lowest yields were produced on Sharkey and Alligator soils.

After 1950 most of the experiments were abandoned and those which were continued were altered. The rate of nitrogen used was increased and in some cases higher rates of phosphorus and potash were applied. The results of these experiments varied little from the 1949 and 1950 results. All of these locations were selected without regard to the results of soil analysis. No effort was made to select areas with any specified level of phosphorus and potash. In 1956 a new series of experiments was initiated to make further study on phosphorus and potash. All of these sites were selected by use of soil test information. In every case the chemical test suggested the likelihood of a response. All of the experiments with any specific level of phosphorus and potash. In 1956 a new series of experiments was initiated to make further study on phosphorus and potash. All of these sites were selected by use of soil test information. In every case the chemical test suggested the likelihood of a response. All of the experiments of 3 years but due to changes in the owners' planting plans only a few were conducted for more than one year. The results are shown in Table 17. There were 10 locations where phosphorus was varied. In 4 tests a response to phosphorus was indicated and no response was indicated in 6 tests. There were 12 locations in which

Table 16. The influence of nitrogen, phosphorus, and potassium on cotton production on different soils, 1949 and 1950.

	Dundee soils				Bosket & Dubbs		Collins[2]	
	Average of 7 locations[1]		Average of 10 locations		Average of 12 locations		Average of 4 locations	
Treatment	Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase
				Pounds of seed cotton per acre				
0-0-0	1156	......	1085	......	1678	......	1436	......
60-0-0	1466	310	1630	545	2102	424	1679	243
60-0-40	1861	705	1630	545	2138	460	1701	265
60-40-0	1582	426	1652	567	2139	461	1691	255
60-40-40	1776	620	1674	589	2141	463	1785	349
60-80-80	1941	785	1724	639	2143	465	2073	637

	Sharkey and Alligator		Forestdale and Brittain	
	Average 10 locations		Average 5 locations	
	Yield	Increase	Yield	Increase
0-0-0	821	......	924	......
60-0-0	1375	554	1524	600
60-0-40	1356	535	1447	523
60-40-0	1412	591	1460	536
60-40-40	1393	572	1455	531
60-80-80	1404	583	1562	638

[1] Seven locations showed a significant response or strongly indicated a response to potassium and five locations responded to phosphorus.

[2] Two locations showed a response to phosphorus and potash. All treatments were made before planting.

Table 17. The influence of nitrogen, phosphorus, potash and lime on the yield of cotton.

Treatment	Soil type and number of years												
	435 1-Yr.	435 1-Yr.	435 1-Yr.	435 1-Yr.	435 1-Yr.	435 2-Yr.	435 1-Yr.	435 1-Yr.	436 3-Yr.	446 1-Yr.	535 1-Yr.	425 2-Yr.	456 1-Yr.
	Pounds of seed cotton per acre												
0-0-0	1610	784	956	1152	2135	1687	......	....	1247	2544	1164	1028	1501
N-O-K	1360	676	1084	1530	1802	1769	......	....	1628	2616	1513	1556	2718
N-40-K	1332	825	1182	1523	1853	1780	......	....	1701	2757	1691	1603	2556
N-80-K	1387	830	1139	1697	1820	1819	......	....	1736	2829	1535	1644	2676
N-120-K	1471	844	1195	1707	1793	1779	......	....	1821	2915	1595	1551	....
											2-Yr.		
N-P-O	1351	868	1057	1387	2163	1935	818	1343	1447	2648	1125	1642	2307
N-P-40	1339	911	1154	1555	2008	1923	784	1234	1706	2586	1315	1613	2474
N-P-80	1439	820	1201	1690	2107	1897	784	1334	1741	2665	1384	1695	2390
N-P-120	1538	920	1161	1748	2016	1981	732	1227	1780	2696	1477	1703	....
No lime	1108	......	1034	....	....	1729	693	1344	....	....	1198	1566	2772
Lime	1205	......	1025	....	....	1799	759	1454	....	....	1205	1829	2874

Soil types: 435—Dundee silt loam.
436—Dundee fine sandy loam.
446—Dubbs fine sandy loam.
425—Forestdale silt loam.
535—Collins silt loam.
456—Bosket fine sandy loam.

When phosphorus was varied 120 pounds of N and K_2O per acre were applied.
When potassium was varied 120 pounds of N and P_2O_5 per acre were applied
All treatments were made before planting.

potash was tested. Four tests showed a response to potash and 8 tests showed no response.

In an experiment at the Delta Station which was started in 1947 annual treatments of phosphorus and potash have been made and the effect on the cotton yields determined. The rates of application of nitrogen, phosphorus, and potash have been changed but in no case has phosphorus been applied where treatments indicated no phosphorus nor has potash been applied where the treatment required no potash. Because of the change in rates of application only the last 5 years are reported in Table 18. The 5-year average results show no significant response to the use of phosphorus and potash. In this experiment a significant response to phosphorus was measured in 1954 at the higher levels of nitrogen and when potash was applied. No explanation can be suggested why a response was measured in one year and not in other years.

Table 18. Rates of nitrogen, phosphorus, and potash for cotton production, Delta Station.

Treatment	1954	1955	1956	1957	1958	1959	6-Yr. avg.
			Pounds of seed cotton per acre				
60-0-0	1604	2652	1432	2171	2311	2542	2119
60-40-0	1711	3012	1509	2328	2525	2703	2298
60-80-0	1693	2887	1503	2340	2450	2700	2262
60-0-80	1803	2753	1684	2228	2649	2670	2298
60-40-80	1553	2979	1592	2331	2569	2732	2293
60-80-80	1678	2934	1485	2426	2450	2774	2290
90-0-0	1589	2970	1622	2456	3020	2899	2426
90-40-0	1699	3157	1726	2328	3309	3148	2561
90-80-0	1871	3089	1758	2370	3243	3086	2570
90-0-80	1648	2931	1654	2177	2934	2925	2378
90-40-80	1708	2952	1553	2189	2819	3009	2372
90-80-80	1841	3119	1821	2156	2994	3127	2510
120-0-0	1860	3166	1821	2269	3267	3252	2606
120-40-0	1714	3163	1559	2302	2851	3020	2435
120-80-0	1628	3070	1515	2462	3107	3119	2484
120-0-80	1586	3062	1518	2441	3178	3065	2475
120-40-80	1972	3175	1803	2302	3015	3279	2591
120-80-80	1821	3142	1636	2225	3101	3080	2501
			Rates of Phosphorus (average)				
0	1682	2899	1642	2084	2893	2893	2349
40	1726	3077	1664	2057	2848	2982	2392
80	1755	3041	1620	2095	2891	2982	2397
			Rates of Potash (average)				
0	1707	3018	1605	2106	2898	2939	2379
80	1734	2982	1639	2052	2857	2963	2371

Soil type—Bosket silt loam.
Time of application—Before planting.
Source of N—Anhydrous ammonia.
Source of P—Superphosphate.
Source of K—Muriate of potash.

Table 19. Effect of lime and magnesium on the yield of cotton on different soils 1949 and 1950.

Treatment	Soil types				
	Dundee soils 6 locations	Bosket & Dubbs 7 locations	Collins	Sharkey & Alligator 3 locations	Forestdale & Brittain 3 locations
	Pounds of seed cotton per acre				
60-40-40	1749	2189	....	1428	1651
60-40-40 + Magnesium	1827	2120	....	1372	1741
	10 locations	8 locations	3 locations[1]	7 locations	3 locations[2]
60-40-40	1784	2208	1358	1232	1445
60-40-40 + Lime	1791	2168	1458	1233	1557

[1] One test on collins silt loam showed a significant response to lime.
[2] One test on Forestdale showed a significant response to lime.
All treatments were made before planting.

Lime and Magnesium for Cotton

In the series of experiments conducted in 1949 and 1950 studying response to phosphorus and potash, lime and magnesium treatments were included in many cases. Magnesium was applied at the rate of 50 pounds of MgO per acre with magnesium sulphate as the source. Lime was applied at a rate designed to raise the pH to 6.5. The basic treatment involved where lime and magnesium were used was 60 pounds of nitrogen, 40 pounds of P_2O_5, and 40 pounds of K_2O. Table 19 lists the yields of 19 experiments where magnesium was used and 33 experiments where lime was used. In no case was there a response to magnesium. There were two experiments which showed a significant response to lime.

In the series of experiments begun in 1956, where phosphorus and potash were studied on those sites which had a pH of 5.2 or lower a lime treatment was added. In these experiments lime was added to plots which received 120 pounds of nitrogen with no phosphorus or potash. There were 8 locations in which lime was used. One site on a Forestdale soil showed a significant response to lime in each of the 2 years of the test. The increased earliness of the cotton at this location was more striking than the increase in yield. At 5 other test areas the yield was slightly higher where lime was used but the increase was not statistically significant and observation during the growing season and at harvest time suggested little or no response to lime treatment. In none of the 5 tests was there any increased earliness which was attributable to the lime treatment.

Sulfur for Cotton.—During recent years numerous small areas of cot-

Table 19A. Effect of a minor element mixture on the yield of cotton, Delta Station.

Treatment	1954	1955
	Pounds of seed cotton per acre	
120-80-80	1821	....
120-80-80 + Minor Elements	1628	....
75 pounds of N per acre	....	2824
75 pounds of N + Minor Elements	....	2819
400 lb. 6-24-24 + 51 pounds of N	....	2955
400 lb. 6-24-24 + 51 pounds of N + Minor Elements	....	2726

Minor element mixture consisted of copper, zinc, boron, and manganese.
Soil type—Bosket loam.
Time of treatment—Before planting.

ton have exhibited symptoms of sulfur deficiency in the Delta. In most cases the deficiencies have been associated with soils having a very high sand content. Frequently, heavy cuts on graded fields also show sulfur deficiency symptoms. These symptoms are characterized by yellowing of the leaves especially the younger leaves. Usually a darker color prevails along the leaf veins. The yellow color is somewhat brighter in appearance than is usually associated with a nitrogen deficiency although the general appearance is similar.

There are no yield data available showing response of cotton to sulfur in the Delta. There have been several field trials and it has been demonstrated that 150 pounds of ammonium sulfate or 200 pounds of gypsum per acre will correct the deficiency indicated by plant appearance. Where the deficiency needs to be corrected in a growing crop, ammonium sulfate is considerably quicker acting than gypsum. It is not intended to suggest that the sources and rates of sulfur mentioned are the proper treatments. More field work will be necessary for this determination. It is suggested that it has been demonstrated that ammonium sulfate or gypsum at the rates mentioned will alleviate the problem.

Minor Elements for Cotton

Very little work has been done with minor elements in the Delta. During the period 1939-1943 various minor elements were tried but no response was measured. In 1954 a minor element mixture consisting of copper, zinc, boron and manganese was added to a base treatment of nitrogen phosphorus, and potash. In 1955 minor elements were tried with nitrogen alone and with nitrogen, phosphorus, and potash. The yields are listed in Table 19A. They show no benefit for minor elements.

Corn Fertilization

Sources of Nitrogen for Corn

In the nitrogen sources experiment described in the cotton section a rotation consisting of cotton, corn and oats was used. Table 20 shows the corn yields obtained where the different nitrogen sources were applied. In this experiment all materials were applied at the rate of 30 pounds of nitrogen per acre through 1951. In 1952 the rate of application was increased to 120 pounds per acre for corn. In addition to this change anhydrous ammonia was substituted for the mixture of cottonseed meal and sodium nitrate.

The 37-year average yields show little difference between sources except that cottonseed meal was slightly inferior to other materials. The planting date in this experiment varied from the first week in April until June 1, but in most years the corn was planted between April 25 and May 5.

Additional sources comparisons for corn have been made and the results showed very little difference among the sources. In most cases the rate of application was constant. In 1950, an experiment was initiated to compare anhydrous ammonia, ammonium nitrate, sodium nitrate, and cyanamid at rates of 60, 90, 120, 150, and 180 pounds of nitrogen per acre. In this experiment all nitrogen materials were applied at a depth of 6 to 8 inches before planting. Dixie 22 was the variety planted.

The 9-year results show no interaction between sources and rates of nitrogen in their effect on yield. When cyanamid was applied at rates of 120 pounds per acre or more there was considerable burning of the plants during early growth and the effect was noticeable for 6 to 7 weeks. This early toxic effect apparently did not influence the yield. Since there was no interaction between sources and rates the results of the 90-pound rate only is reported in Table 21. This rate was selected because it was slightly below the maximum rate of nitrogen which increased yields. The average results of the 4 sources show no significant differences among them.

Rates of Nitrogen for Corn

In 1921, an experiment was begun which compared nitrogen rates varying in 7-1/2 pound increments up to 45 pounds of nitrogen per acre. Nitrate of soda was used as the source of nitrogen and was applied before planting. The 37-year results of this experiment are reported in Table 22. The average yields show that the yield of corn increased as the rate of nitrogen

Table 20. Effect of sources of nitrogen on the yield of corn, Delta Station.

Treatment	1921-1951 average	1952-1957 average	37-Year average
		Bushels of corn per acre	
No Nitrogen	24.5	25.1	24.6
Sodium nitrate	41.6	59.5	44.5
Ammonium nitrate	43.2	62.3	46.4
Ammonium sulphate	39.8	61.4	43.3
Cyanamid	39.8	62.6	43.5
Cotton-seed meal	35.2	40.8	36.1
One-half Cottonseed meal and one-half sodium nitrate	36.3	......	......
Anhydrous ammonia	......	63.8	......

Soil type—Bosket silt loam predominates with small areas of Dubbs included.
Rate of nitrogen—30 pounds per acre 1921 through 1951.
120 pounds per acre 1952 through 1957.
Time of application—one to three weeks before planting.

Table 21. Yield of corn with different sources of nitrogen, Delta Station, 1950-1959.

Nitrogen source	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	10-Yr. avg
					Bushels of corn per acre						
No nitrogen	38.0	25.6	21.7	47.7	26.4	50.0	35.6	37.1	17.2	16.2	31.6
Cyanamid	91.6	55.0	54.2	87.4	56.4	95.6	84.1	74.0	68.9	73.5	74.1
Ammonium nitrate	83.0	58.2	53.9	85.7	60.0	97.0	85.2	68.0	70.2	75.7	73.7
Anhydrous ammonia	87.6	59.9	54.3	82.3	63.3	88.5	87.8	63.6	62.5	68.8	71.9
Sodium nitrate	86.2	58.6	47.3	77.5	51.0	99.4	88.1	61.7	66.3	68.6	70.5

Soil type—Bosket silt loam.
Rate of nitrogen—90 pounds of N per acre.
Time of application—One to three weeks before planting.

increased with considerable variation in yield among years.

As a supplement to the experiment described in the preceding paragraph an experiment was started in 1951 beginning with 45 pounds of nitrogen per acre and increasing to 120 pounds per acre in 15-pound increments. Table 23 reports the 7-year average yields of this experiment. The highest yields were produced when 120 pounds of nitrogen per acre were applied but the increase over 105 pounds was only 1.8 bushels per acre.

In a sources and rates experiment where the rate of application varied from 60 to 180 pounds of nitrogen per acre in 30-pound increments the yield was not increased by exceeding 120 pounds of nitrogen per acre. The results are shown in Table 24. There were consistent increases up to that level. In this test lodging increased as the rate of nitrogen increased and became quite severe at the rate of 150 and 180 pounds of nitrogen per acre.

A nitrogen rates experiment was conducted on a Sharkey clay soil from 1953 through 1958. Ammonium nitrate was used as the nitrogen source and was applied near planting time either just before or within a very short time after planting. It was necessary to abandon the experiment in 1954. Table 25 shows the 5-year yields of corn where the varying rates of nitrogen were applied. Tremendous variation in the yield level resulted from varying weather conditions among years. The corn yields increased as the rate of nitrogen increased up to 120 pounds per acre but showed no benefit from rates exceeding 120 pounds. Although it was not consistent there was an indication that yields might have been slightly reduced at the highest levels of nitrogen application in 1955 and 1956. This could have been associated with the greater weed growth on the high nitrogen plots.

Time of Applying Nitrogen for Corn

An experiment was begun in 1951 to compare pre-plant, split-application, and side dressing application of nitrogen for corn. The experiment was located on a Bosket silt loam soil. Anhydrous ammonia and ammonium nitrate were used as sources and were applied 6 to 8 inches deep at the rate of 120 pounds of nitrogen per acre. The variety used was Dixie 22. Table 26 lists the yields of corn from the two sources applied at the three times. The highest yields were produced when the nitrogen was applied prior to planting and no difference existed between anhydrous

Table 22. The influence of rates of nitrogen on the yield of corn, Delta Branch Experiment Station, 1921-1957.

Year	No nitrogen	Pounds of nitrogen per acre					
		7.5	15.0	22.5	30.0	37.5	45.0
	Yield in bushels of corn per acre						
1921	40.5	41.4	43.2	44.5	46.0	44.8	44.0
1922	32.7	34.4	38.4	45.1	48.2	54.8	56.4
1923	30.3	31.7	35.1	42.9	44.2	43.7	50.4
1924	26.3	29.5	32.2	39.2	40.2	42.3	42.4
1925	26.1	29.1	31.2	32.5	30.4	29.5	28.9
1926	26.3	30.2	34.9	39.2	43.2	47.5	46.0
1927	30.9	36.4	46.0	50.3	62.8	62.5	61.7
1928	31.6	40.3	49.3	55.9	66.5	73.9	73.7
1929	12.6	14.5	21.1	22.8	30.9	32.6	33.4
1930	11.9	13.1	16.7	20.7	24.6	26.9	27.3
1931	45.3	62.1	63.8	59.7	55.5	52.5	55.7
1932	14.3	15.4	21.7	25.1	35.3	38.1	39.9
1933	15.3	14.2	16.5	18.4	22.4	25.9	28.4
1934	12.4	14.2	19.3	23.0	27.0	28.8	28.9
1935	11.5	12.2	18.1	22.4	29.9	35.8	36.5
1936	10.0	12.8	13.5	15.2	19.0	21.1	20.4
1937	11.1	16.1	20.2	27.5	33.4	33.7	35.9
1938	14.5	15.4	21.4	23.3	32.5	40.5	44.3
1939	11.2	14.8	17.7	21.8	25.9	28.7	30.5
1940	47.9	49.3	52.9	57.9	61.4	63.8	67.2
1941	30.9	32.4	39.2	41.7	43.5	45.8	50.3
1942	29.1	34.4	43.2	47.4	54.3	57.9	62.5
1943	15.4	20.1	25.2	30.6	34.6	33.9	38.9
1944	15.6	15.7	16.9	23.1	24.3	23.9	22.1
1945	43.2	48.9	55.8	65.6	67.1	74.6	77.8
1946	39.2	39.6	44.9	55.1	62.3	67.3	72.1
1947	20.1	24.0	28.8	32.6	39.1	43.8	48.5
1948	22.9	23.7	31.7	33.6	41.3	44.8	48.1
1949	35.8	40.0	45.4	54.4	62.5	68.5	74.0
1950	27.7	30.6	39.6	46.5	50.4	59.8	63.7
1951	22.5	23.2	27.9	32.8	33.8	38.5	45.5
1952	21.4	25.2	30.9	34.2	41.6	49.1	51.2
1953	20.5	24.9	32.1	36.7	40.4	42.3	46.9
1954	23.7	30.8	35.0	41.4	43.6	40.2	44.4
1955	16.6	17.5	23.0	26.1	30.7	34.2	37.1
1956	33.4	44.5	42.6	48.5	50.0	53.2	55.6
1957	35.0	39.7	45.3	45.3	53.5	59.7	60.5
Average	24.8	28.1	33.0	37.4	42.0	45.0	47.3

Soil type—Bosket silt loam.
Source of nitrogen—Sodium nitrate.

ammonia and ammonium nitrate. When the nitrogen was applied as a side dressing there was a slight advantage for ammonium nitrate over anhydrous ammonia. In 5 of the 7 years, side dressing with ammonium nitrate produced yields significantly higher than anhydrous ammonia. In most cases ammonium nitrate applied as a side dressing took effect somewhat sooner than anhydrous ammonia. It should be pointed out however, that the ammonium nitrate was applied 6 to 8 inches deep in the same manner as anhydrous ammonia.

Placement of Nitrogen on Corn

An experiment was initiated in

Table 23. The effect of rates of nitrogen on corn production, Delta Station, 1959-1958.

Pounds of N per acre	1951	1952	1953	1954	1955	1956	1957	7-Yr. average
Planting date	5/10	5/10	5/23	4/19	4/30	4/21	5/31	
				Bushels per acre				
0	15.9	26.6	16.3	21.6	26.4	26.3	36.9	24.3
45	44.2	55.0	35.3	48.6	49.5	40.3	66.7	48.5
60	54.5	64.5	38.0	67.8	63.6	46.4	70.2	57.9
75	63.6	63.9	47.0	66.6	68.7	52.8	77.6	62.9
90	71.8	67.4	42.4	65.1	68.1	55.5	80.0	64.3
105	75.5	71.2	46.8	70.5	72.3	58.0	82.1	68.1
120	81.1	71.9	45.9	68.4	83.9	58.5	79.8	69.9

Soil type—Bosket silt loam.
Nitrogen source—Anhydrous ammonia.
Date applied—one to three weeks before planting.
Variety—Dixie 22.

Table 24. The effect of rates of nitrogen on the yield of corn, Delta Station, 1950-1960.

Pounds of N per acre	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	11-Yr avg.
						Bushels of corn per acre						
No nitrogen	38.0	25.6	21.7	47.7	26.4	50.0	35.6	37.1	17.2	16.2	17.3	30.3
60	74.0	47.1	44.4	80.4	56.7	85.3	69.7	63.0	62.3	55.6	44.8	62.1
90	87.1	57.9	52.4	83.2	57.7	95.1	86.3	66.8	67.0	71.7	54.9	70.9
120	97.5	68.7	53.5	84.4	58.1	102.8	91.5	72.1	85.0	80.8	62.0	77.9
150	98.1	67.4	51.1	73.3	52.1	101.2	85.3	77.2	86.5	82.1	54.7	75.4
180	99.5	54.4	49.9	80.5	61.3	94.4	93.6	74.9	84.1	71.2	60.6	74.9

Soil type—Bosket silt loam.
Nitrogen source—Each yield represents an average of plots receiving cyanamid, ammonium nitrate, anhydrous ammonia and sodium nitrate.
Time of application—Before planting.
Corn spacing—1 plant per foot of row.

Table 25. Effect of rates of nitrogen on corn production on Sharkey Clay, Delta Station, 1953-1958.

Pounds of N per acre	1953	1955	1956	1957	1958	5-Yr. avg.
			Bushels of corn per acre			
0	12.4	65.5	18.8	7.2	8.7	22.5
60	21.8	84.1	48.5	35.3	18.9	41.7
90	19.8	80.7	43.5	40.3	27.4	42.3
120	17.3	90.7	50.9	47.6	31.7	47.6
150	21.4	89.1	41.3	54.6	36.7	48.6
180	20.1	86.7	44.1	55.5	30.7	47.4

Nitrogen source—Ammonium nitrate.
Variety—Dixie 22.

1949 to study the effect of nitrogen at varying distances from the seed drill on the yield of corn. The test was located on a Bosket silt loam soil and anhydrous ammonia and ammonium nitrate were used as sources. Each material was applied before planting, 6 to 9 inches deep, at the rate of 120 pounds of nitrogen per acre. A poor stand caused abandonment of the experiment in 1953. The 5-year results of this test are shown in Table 27. There were no significant differences in yield which were attributable to placement. The average yield when the nitrogen was placed 20 inches from the drill was slightly lower than the other treatments. It was observed that 3 to 5 weeks elapsed each year before a color change in the corn indicated that the nitrogen was being taken up when placed 20 inches from the drill. In this test the average yield of the plots treated with ammoni-

Table 26. Effect of time of applying anhydrous ammonia and ammonium nitrate on the yield of corn.

Treatment	1951	1952	1953	1954	1956	1957	1958	Average
			Bushels of corn per acre					
No nitrogen	19.6	14.4	23.3	9.5	34.1	36.1	17.2	22.0
Anhydrous ammonia								
preplant	68.6	69.5	73.1	79.4	99.6	69.7	85.9	78.0
split	70.6	69.3	64.4	77.3	94.1	60.2	74.2	72.9
side dress	65.4	66.7	64.9	77.1	93.4	55.9	74.8	71.2
Ammonium nitrate								
preplant	67.0	72.7	73.3	82.0	104.0	67.8	83.3	78.6
split	73.4	66.8	70.4	82.3	97.2	63.5	77.3	75.8
side dress	76.5	69.2	72.8	82.4	96.8	62.8	81.5	77.4

Soil type—Bosket silt loam.
Rate of nitrogen—120 pounds of N per acre.
Depth of application—6 to 8 inches deep.

Table 27. Influence of placement of nitrogen at varying distances from the seed drill on the yield of corn.

Placement	1949	1950	1951	1952	1954*	Avg.
			Bushels of corn per acre			
No treatment	50.7	35.6	13.0	13.5	18.1	26.2
Directly beneath seed	89.7	94.8	67.8	50.7	73.3	75.3
6 inches to one side of seed	90.0	94.1	68.4	48.8	72.0	74.7
In two bands 6 inches from seed drill	90.3	96.0	67.2	49.4	78.5	76.3
20 inches from seed drill	87.5	93.6	66.8	45.9	76.8	74.1

Soil type—Bosket silt loam.
Nitrogen source—Each yield is an average of plots receiving anhydrous ammonia and ammonium nitrate.
Rate of nitrogen—120 pounds of N per acre.
Depth of placement—6 to 9 inches deep.
Time of application—One to three weeks before planting.
*Test was abandoned in 1953 due to poor stand.

um nitrate was 90.7 bushels per acre and the yield of the plots treated with anhydrous ammonia was 88 bushels per acre.

A test designed to measure the effect of varying depths of placement of nitrogen on the yield of corn was conducted from 1951-1954. Previous work had shown an advantage for placing nitrogen 10 to 12 inches deep when compared with placement 2 to 3 inches deep but no intermediate depths were used. This experiment was located on a Bosket loam. Anhydrous ammonia and ammonium nitrate were used as sources and were applied at the rate of 120 pounds of N per acre, before planting, 6 to 8 inches to the side of the seed drill. The nitrogen was placed 4, 6, 8, and 10 inches deep. The results are listed in Table 28. The results show a slight increase in yield to a depth of 8 inches. This was true in 3 of the 4 years in which the test was conducted. There was no indication that there was a lag in the nitrogen being taken up from the deeper treatments.

Phosphorus and Potash for Corn. In 1949 and 1950 approximately 45 experiments were conducted with corn in which the effect of phosphorus and potash was studied. Except for the check plots all plots received a uniform treatment of 120 pounds of nitrogen per acre. These experiments were scattered throughout the Delta area. Superphosphate was used as the source of phosphorus and muriate of potash supplied the potassium. In all cases the fertilizer was applied before planting. Table 29 lists the results of 31 experiments with the yields averaged for similar soils. Other experiments which were conducted during this same time are not included in the table because of lack of uniformity within the plot area or because only one experiment was conducted on a particular soil type. In all of the tests conducted there was only one experiment where a response to phosphorus was obtained in harvested yields. There were no tests where a response to potash occurred. There were 3 or 4 locations on Bosket and Dundee soil where phosphorus increased the rate of seedling growth but yields were not affected.

In addition to the tests which were conducted in 1949 and 1950 several other one-year experiments

Table 28. Effect of depth of placement of nitrogen on the yield of corn.

Depth of placement	1951	1952	1953	1954	Average
		Bushels of corn per acre			
No treatment	31.6	17.5	41.4	24.6	28.8
4 inches	57.8	56.4	84.9	65.7	66.2
6 inches	66.3	61.8	82.8	68.3	69.8
8 inches	69.2	63.1	84.8	71.5	72.1
10 inches	71.2	61.7	85.2	67.8	71.5

Soil type—Bosket loam.
Rate of nitrogen—120 pounds of N per acre.
Source of nitrogen—Each yield figure is an average of anhydrous ammonia and ammonium nitrate treated plots.

have been run since that time. The results have been similar with no response to phosphorus and potash indicated by harvested yields.

Lime and Magnesium for Corn

In the experiments conducted in 1949 and 1950 where phosphorus and potash were studied, treatments were added to measure the effect of lime and magnesium. In each case the basic treatment was 120 pounds of nitrogen, 40 pounds of P_2O_5, and 40 pounds of K_2O per acre. Magnesium was applied at the rate of 50 pounds of MgO per acre with magnesium sulphate used as the source. Table 30 shows the yields of corn in 12 experiments where magnesium was added and 22 experiments where agricultural lime was added. The lime was added at a rate calculated to bring the pH of the soil to 6.5. In no case was there a significant response to the addition of lime or magnesium.

Rates of Nitrogen for Corn Interplanted With Soybeans

An experiment was begun in 1950 to study the effect of varying rates of nitrogen on the yield of corn with and without soybeans interplanted. There were 2 years when the test was not planted and 3 years when the stand of soybeans was so poor that the yields were not reported. Table 31 lists the corn yields with and without soybeans at the varying levels of nitrogen for 5 years between 1950 and 1960.

In this test anhydrous ammonia was used as the source of nitrogen and was applied before planting. Ogden soybeans were planted in 1950 and Lee in the other years reported. The soybeans were harvested in 1950 only and averaged 10 bushels per acre with no difference among nitrogen rates. In the other years the soybeans were not harvested but yield estimates indicated a production of 10 to 12 bushels per acre with no difference among nitrogen rates. In 1958 the yield of corn was reduced at all levels of nitrogen by the soybeans. In 1959 and 1960 the yield of corn was increased by the interplanted soybeans on the unfertilized plots and on 60- and 90-pound-nitrogen treatments.

The average yields for the 5 years reported show very little difference in yields between corn with soybeans interplanted and corn without soybeans.

Table 30. Effect of lime and magnesium on the yield of corn on different soils.

Treatment	Dundee soils 3 locations	Bosket & Dubbs 2 locations	Collins	Sharkey & Alligator 4 locations	Forestdale & Brittain 3 locations
	Bushels of corn per acre				
120-40-40	76.4	72.5	......	53.3	55.5
120-40-40 + MgO	73.4	68.7	......	54.4	55.9
	4 locations	4 locations	2 locations	6 locations	6 locations
120-40-40	71.3	76.2	67.9	51.0	62.9
120-40-40 + lime	71.8	73.2	68.1	52.9	63.6

All treatments were made before planting.

Table 29. Nitrogen, phosphorus, and potassium for corn production on different soil types, 1949 and 1950.

	Dundee				Bosket & Dubbs		Collins		Sharkey & Alligator		Forestdale & Brittain	
Treatment	6-Test average yield	6-Test average increase	One-test* yield	One-test* increase	7-Test average yields	7-Test average increase	3-Test average yield	3-Test average increase	7-Test average yield	7-Test average increase	7-Test average yield	7-Test average increase
						Bushels of corn per acre						
0-0-0	35.0	......	34.4	......	38.1	......	39.0	......	27.2	......	30.0	......
120-0-0	69.4	34.4	45.1	10.7	81.6	43.5	79.7	40.7	54.5	27.3	60.6	30.6
120-0-40	68.1	33.1	45.9	11.5	80.6	42.5	78.1	39.1	53.1	25.9	62.3	32.3
120-40-0	67.6	32.6	54.7	20.3	82.9	44.8	77.8	38.8	52.6	25.4	60.4	30.4
120-40-40	68.9	33.9	55.1	20.7	82.5	44.4	77.9	38.9	52.5	25.3	62.9	32.9
120-80-80	65.9	30.9	56.5	22.1	83.5	45.4	75.5	36.5	53.9	26.7	61.5	31.5

*A significant response to phosphorus was obtained in this test.
All treatments were made before planting.

Table 31. The effect of interplanting soybeans in corn on the yield of corn at different nitrogen levels.

	1950		1956		1958		1959		1960		5-Year average	
Pounds of N per acre	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans	No soybeans	With soybeans
						Bushels of corn per acre						
0	52.2	38.6	22.2	22.7	15.9	14.4	16.7	31.6	25.8	40.6	26.6	29.6
60	83.9	74.3	46.5	46.5	41.3	35.5	37.3	41.1	42.4	46.2	50.3	48.7
90	94.5	91.0	57.3	59.9	42.7	36.1	53.0	56.9	46.0	51.5	58.7	59.1
120	100.9	101.3	60.0	67.6	67.4	55.6	72.0	76.0	62.1	60.7	72.5	72.2
150	104.1	101.4	66.0	74.4	67.5	57.6	72.5	69.9	63.4	54.9	74.7	71.6

Soil type—Dubbs silt loam.
Time of nitrogen application—Five to 15 days before planting.

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Fusarium Wilt Of Cotton

Can Be Controlled With

Resistant Varieties

Or

Soil Fumigation

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director
STATE COLLEGE MISSISSIPPI

JUN 17 1961

FUSARIUM WILT OF COTTON CAN BE CONTROLLED WITH RESISTANT VARIETIES OR SOIL FUMIGATION

By C. D. RANNEY

In spite of available control measures, Fusarium wilt remains one of the most destructive diseases of cotton in Mississippi. In the last three crop years this disease has caused losses of approximately 22,800 bales each season. At a nominal value of $135.00 per bale, this means an entirely unnecessary loss of over $3,000,000 has occurred each year. During this period numerous adapted varieties of cotton resistant to this disease have been available commercially. In addition to this method of control, work conducted in the late 1940's by the Mississippi Agricultural Experiment Station showed the positive value of controlling this disease by soil fumigation with nematocides.

Unlike many other cotton diseases, Fusarium wilt requires some help in attacking the cotton plant. It is an opportunist that depends on damage or wounds from some source to give it an entrance to the plant. While close cultivation causes some root damage, the main assistants to this disease are nematodes. Nematodes are microscopic parasitic worms that feed on the small cotton roots.

In addition to weakening the plant by their feeding action, the nematodes produce wounds that the wilt fungus utilizes as doorways to the cotton plant. While soil fumigation is somewhat effective in killing the wilt fungus in the soil, the main action of the nematocide is in reducing the nematode populations.

With the present program of acreage control, cotton is increasingly following cotton on the more productive sandy loam soils. This practice is causing the severity of wilt to increase.

Procedure

In 1960 tests were undertaken to study the value of both resistant varieties and soil fumigation in reducing losses due to wilt under present production practices. Test sites were selected on land that exhibited moderate to very severe losses due to the wilt-nematode complex in 1959. A site near Mayersville, Mississippi, incurred moderate losses while locations near Shaw and Clarksdale, Mississippi, sustained severe losses in 1959. The experimental plots were prepared and fertilized in the manner normally used in cotton production in these areas. The tests were set up as randomized blocks and replicated 5 times at Mayersville and Shaw. At Clarksdale 4 replications were utilized. The soil was fumigated on a 40" row basis with nematocides, Nemagon (1,2-dibromo-3-chloropropane) and D-D (1,3-dicholoropropane and 1,2-dichloropropane), 10 to 21 days prior to planting with application equipment recommended for nematode control. For convenience only two nematocides were used in these tests. There are several other nematocides available commercially that are just as effective as the materials tested.

Mr. Earl B. Minton, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, at Auburn, Alabama, identified the nematode populations at the three locations as follows:

Location	Nematodes per pint of soil				
	Root knot	Stubby root	Root lesion	Tobacco stunt	Total parasitic nematodes
Mayersville	1500	200	40	0	1740
Shaw	800	4500	510	100	5910
Clarksdale	7000	265	10	0	7275

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[1] Plant Pathologist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the Delta Branch of the Mississippi Agricultural Experiment Station, Stoneville, Mississippi.

Results

The test at Mayersville was conducted on plant-four, skip-four cotton. In this test, Deltapine 15 was used as the susceptible variety, Deltapine Fox 4 as an example of a tolerant variety, and Auburn 56 as a highly resistant variety. Under the moderate disease situation that developed here, Deltapine Fox 4 without any nematocide treatment yielded 164 pounds more lint per acre than the susceptible Deltapine 15, and Auburn 56, without additional treatments, returned 132 pounds more than the Deltapine 15 check. Both Deltapine 15 and Fox 4 showed marked yield increases, 69 to over 200 pounds of lint, from the nematocide treatments. Only small increases were obtained with the nematocide treatments in the disease resistant Auburn 56 plots.

Cotton in the test near Shaw, Mississippi, suffered severely from drought during much of the growing season. From mid-July to early September only a trace of rainfall was noted in this field, resulting in low yields. In spite of the lower yields, substantial increases

Table 1. Effect of cotton varieties and nematocides on the yield of cotton in a fusarium wilt-nematode situation near Mayersville, Mississippi, in 1960.

Treatment				Net gain due to varieties		Net gain due to nematocide treatments	
Variety	Material	Gallons per acre	Pounds of lint per acre[1]	Pounds	Dollars[2]	Pounds	Dollars[2]
Deltapine 15	Check[3]		771	....	....	......	....
	Nemagon	½	960			189	+ 46.70
	Nemagon	1	935			164	+ 31.20
	D-D	8	840			69	+ 10.70
Deltapine Fox 4	Check[3]		935	164	+ 49.20	..	....
	Nemagon	½	1117			182	+ 44.60
	Nemagon	1	1141			206	+ 43.80
	D-D	8	1139			204	+ 51.20
Auburn 56	Check[3]		903	132	+ 39.60		..
	Nemagon	½	955			52	+ 5.60
	Nemagon	1	998			95	+ 10.50
	D-D	8	937			34	+ .20

See Table 3 for footnotes.

Table 2. Effect of cotton varieties and nematocides on the yield of cotton in a severe fusarium wilt-nematode situation near Shaw, Mississippi, in 1960.

Treatment				Net gain due to varieties		Net gain due to nematocide treatments	
Variety	Material	Gallons per acre	Pounds of lint per acre[1]	Pounds	Dollars[2]	Pounds	Dollars[2]
Deltapine 15	Check*		95	....	....		....
	Nemagon	½	129			34	+ .20
	Nemagon	1	149			54	— 1.80
	D-D	8	132			37	+ 1.10
Deltapine Fox 4	Check*		136	41	+ 12.30	....	.....
	Nemagon	½	173			37	+ 1.10
	Nemagon	1	180			44	— 4.80
	D-D	8	195			59	+ 7.70
Auburn 56	Check*		160	65	+ 19.50	....	......
	Nemagon	½	200			40	+ 2.00
	Nemagon	1	189			29	— 9.30
	D-D	8	203			43	+ 2.90

See Table 3 for footnotes.

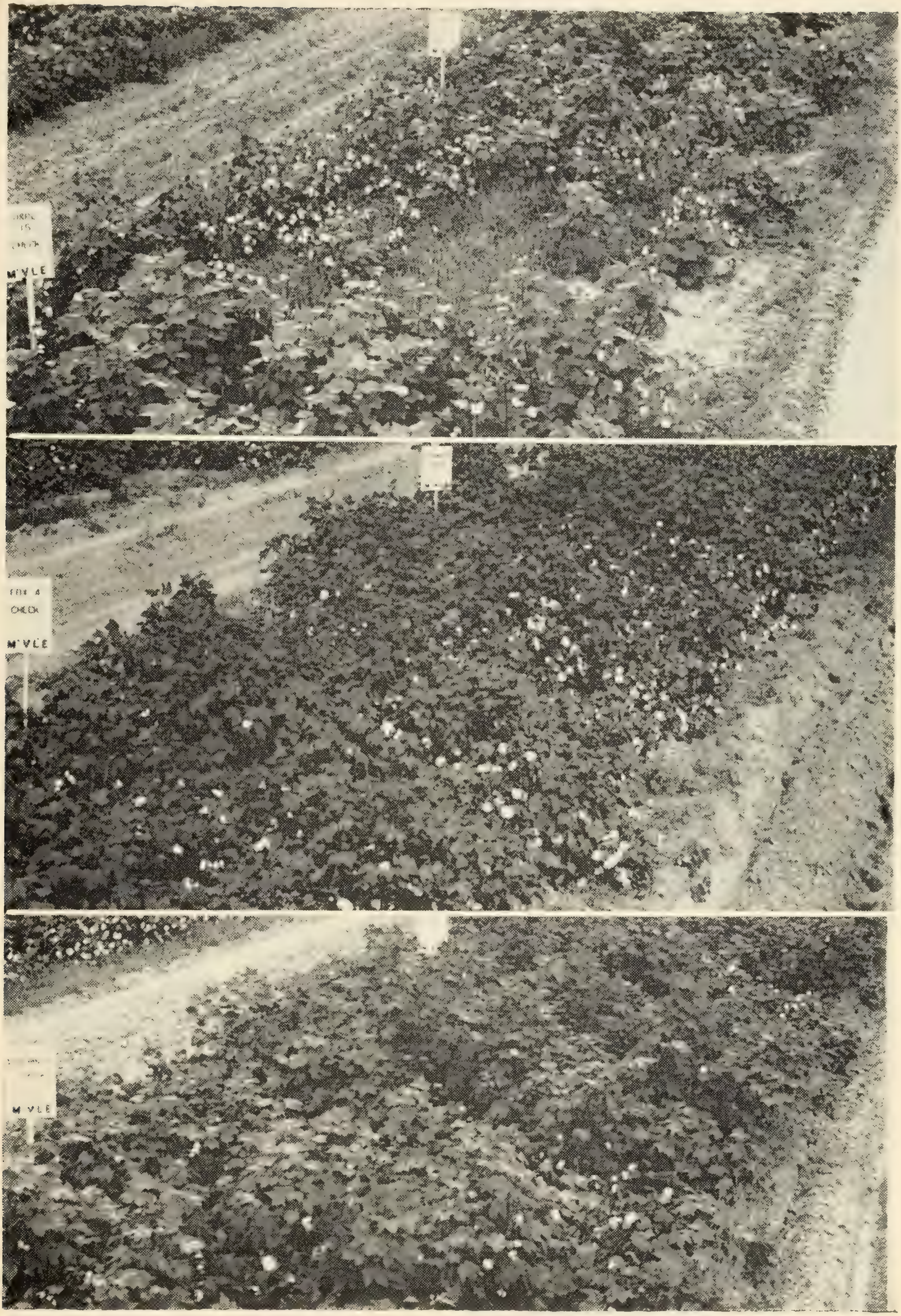
15
CHECK
M'VLE
FOX 4
CHECK
M'VLE
M'VLE

Figure 1. The effect of varieties on control of the Fusarium wilt-nematode complex. At the top, Deltapine 15, in the center, Deltapine Fox 4, at hte bottom, Auburn 56.

were obtained with the tolerant and resistant varieties. Forty-one pounds of lint with Deltapine Fox 4 and a 65 pound increase with Auburn 56 were found. While the nematocide treatments gave definite yield increases, the increased yield in several cases was not sufficient to offset the cost of the treatments.

This test points out one of the risks that should be considered concerning the relatively high cost nematocide treatments under dry-land farming. Use of nematocide treatments represents a high per-acre investment prior to planting, adding to the capital risked in a cotton program. In this case, if the interest on the treatment cost were considered, perhaps several of the plus returns for treatment would not be real.

The test at Clarksdale was also subject to severe damage from the wilt-nematode complex. In this test susceptible varieties are represented by Deltapine Smoothleaf, tolerant varieties by Deltapine Fox 4, intermediate resistant varieties by Rex and highly resistant varieties by Auburn 56. The results again emphasize the value of resistant varieties in reducing disease losses. When compared with the susceptible Deltapine Smoothleaf variety, Deltapine Fox 4 gave a yield increase of 87 pounds of lint, Rex gave an increase of 126 pounds and Auburn 56 returned a 198 pound increase. In this test, under more normal rainfall conditions, when nematocide treatments were used with Deltapine Smoothleaf and Fox 4 excellent increases in yield were obtained resulting in returns of 28 to 60 dollars per acre.

Table 3. Effect of cotton varieties and nematocides on the yield of cotton in a severe fusarium wilt-nematode situation near Clarksdale, Mississippi, in 1960.

Treatment		Gallons per acre	Pounds of lint per acre[1]	Net gain due to varieties		Net gain due to nematocide treatments	
Variety	Material			Pounds	Dollars[2]	Pounds	Dollars[2]
Deltapine Smoothleaf	Check*		359	...	...	...	...
	Nemagon	½	558			199	+ 49.70
	Nemagon	1	520			161	+ 30.30
	D-D	8	593			234	+ 60.20
Deltapine Fox 4	Check*		446	87	+ 26.10	...	
	Nemagon	½	573			127	+ 28.10
	Nemagon	1	686			240	+ 54.00
	D-D	8	638			192	+ 47.60
Rex	Check*		485	126	+ 37.80		...
	Nemagon	½	559			74	+ 12.20
	Nemagon	1	629			144	+ 25.20
	D-D	8	470			— 15	— 14.50
Auburn 56	Check*		557	198	+ 59.40		
	Nemagon	½	557			0	— 10.00
	Nemagon	1	556			— 1	— 18.30
	D-D	8	569			12	— 6.40

[1] Calculated using average lint percents as given in Table 6 Mississippi Cotton Variety Tests for 1959. Mississippi Agricultural Experiment Station Bulletin 589.

[2] This figure is based on the following assumptions:

1. Equal cost of planting seed.
2. Lint value of 30 cents per pound.
3. Cost of material and application per acre as follows:
   ½ gallon of technical Nemagon $10.
   1 gallon of technical Nemagon $18.
   8 gallons of technical D-D $10.

*No nematocide treatment.

Discussion

The results of the variety and nematocide tests conducted in 1960 emphasize the value of using practices that will reduce losses due to the Fusarium wilt-nematode complex. The utilization of varieties with tolerance or resistance to this disease is the most economical means of reducing disease losses. Where large areas are involved this is also the most feasible method. In general, cotton varieties can be grouped in four categories in respect to their reaction to the wilt-nematode complex:

Susceptible — Deltapine Smoothleaf, Deltapine 15, Stardel, Delfos 9169 and Stoneville 3202.

Tolerant—Deltapine Fox 4, Coker 124-C, and Stoneville 7.

Moderately resistant—Rex, Empire W. R., Dixie King, Plains, and Coker 100A.

Highly resistant—Auburn 56.

In addition to having a high level of resistance to Fusarium wilt, the variety Auburn 56 also exhibits resistance to damage from the root-knot nematode. In areas where the disease is light to moderate good control can be expected with tolerant or moderately resistant varieties. Under conditions of severe losses better results can be expected with varieties exhibiting higher levels of resistance such as Auburn 56.

The proper use and application of nematocides will also markedly reduce losses due to this disease complex. In many instances only a small area of a field is subject to damage. Under conditions such as this a spot treatment using nematocides is very practical. This practice, with repeated use, will reduce the nematode populations and limit the spread of the disease within a field.

Summary

Tests at three locations re-emphasized the value of using either resistant varieties or soil fumigation with nematocides to reduce losses due to Fusarium wilt-nematode disease of cotton.

The most economical means of control is with the use of adapted varieties which are resistant to this disease complex. In all of the tests, tolerant or resistant varieties gave marked increases in yield.

When soil fumigation with nematocides was used, increases in both yield and net value of susceptible and tolerant varieties were obtained. Proper use and application of nematocides offers an excellent means of reducing losses in spots or small areas in large plantings.

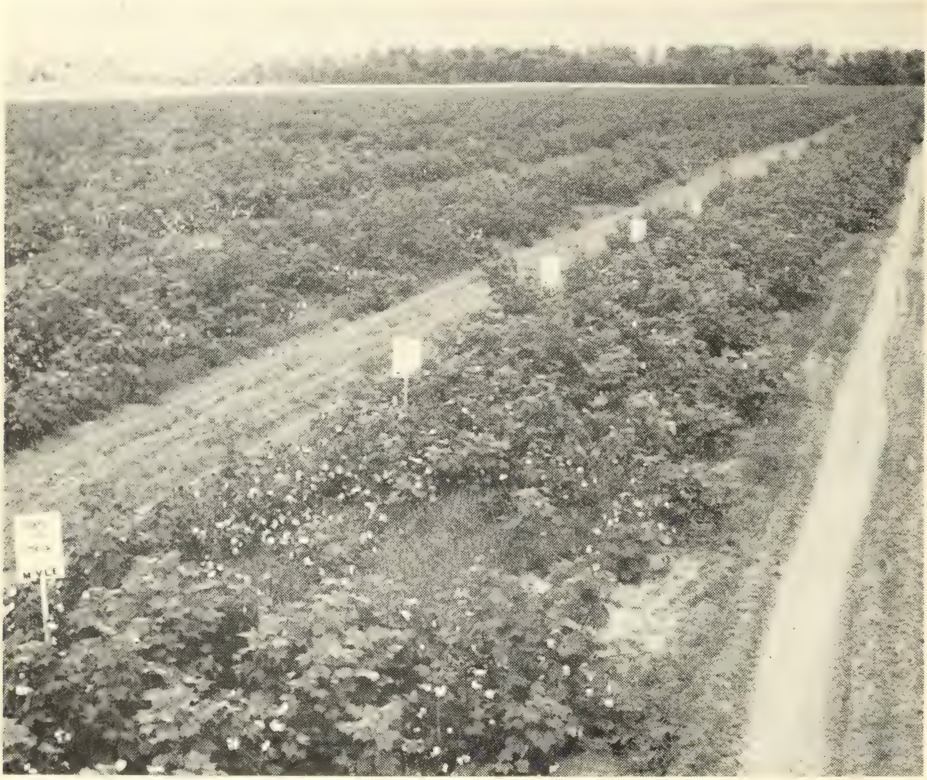

Figure 2. The effect of nematocide treatment on control of the Fusarium wilt-nematode complex. In the foreground is a plot without nematocide treatment, behind this are plots treated with: 1 gallon of Nemagon, 8 gallons of D-D, and ½ gallon of Nemagon respectively. In each plot the variety is Deltapine 15.

Cabbage, Cauliflower, and Broccoli Production in Mississippi

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AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director
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CABBAGE, CAULIFLOWER, AND BROCCOLI PRODUCTION IN MISSISSIPPI

By W. O. THOMAS

Cabbage, cauliflower, and broccoli have many similar requirements and present about the same problems in production.

The cabbage marketing and shipping season in Mississippi extends from mid-April to late May. Cabbage are moved from the Mississippi market by car and truck lot shipments to distant markets. Mississippi growers usually produce a good yield of high quality cabbage. This is primarily due to the growing of locally adapted varieties and following recommended cultural practices. Certain varieties of broccoli and cauliflower are adapted to spring and fall growing conditions. These crops are produced for the fresh market and freezing industry.

Production

Land Selection: Cabbage, cauliflower and broccoli require a well drained soil for maximum production. These crops produce well on a wide range of soil types, but grow best on a deep loam soil.

Fertilizer Requirements and Soil Preparation: Fertilizer recommendations for these crops should be based on a soil test. In case no soil test is made, about 1200 pounds of 6-8-8 or equivalent should be applied in the drill prior to transplanting. The spring crop should be sidedressed with 100 pounds of ammonium nitrate per acre when all danger of late freezes is over. The fall crop should be sidedressed about one month after transplanting. On most soils in Mississippi the addition of 20 to 40 pounds of borax per acre, either mixed into the initial fertilizer application or applied with the sidedressing will prevent brown stem in cabbage, hollow stem in broccoli, and brown core or malformed heads in cauliflower.

Irrigation: These crops require a constant supply of available moisture if high quality produce and good yields are expected. If the soil moisture is depleted to an extent where wilting of the foliage occurs during midday, 1½ to 2 inches of irrigation should be applied at seven-day intervals; continue irrigating at regular intervals until a good rain occurs.

Plant Growing: For spring production, cabbage, cauliflower and broccoli seed are usually planted in a plant bed and plants are transplanted to the field. Under certain conditions seed of these crops may be planted in the field without coldframe protection. If plants are grown in the field, seed should be planted in rows or beds during the first week in October; plants will be ready to transplant to the field by mid-January. If seed are planted in the coldframe, they should be planted about mid-October and transplanted to the field in January.

For fall production, plant seed from mid-July to August 1 in a prepared seedbed. The fall crop should be transplanted from mid-August to September 10. Seed should be sown sparingly in the seedbed; overcrowding tends to produce spindly plants. One pound of seed for these crops planted in a 10 x 70 foot coldframe will produce enough plants for about three acres. (See steps in coldframe preparation and use of soil sterilants).

Planting: When transplanting these crops, always set plants in the afternoon. If the soil is dry at time of transplanting, it is advisable to dip the roots of the plants in a mud slurry when they are pulled from the seedbed and irrigate immediately after transplanting. Cabbage should be spaced 10 to 12 inches in the row and cauliflower and broccoli about 16 inches in the row. Light but frequent cultivations are necessary to keep down grass and weeds.

Varieties

Cabbage: Table 1 lists seven varieties of cabbage in order of general preference.

Although a variety produces a high yield, this does not necessarily mean that it is adapted to a local or specialized market. Round Dutch is well adapted for the commercial market in Mississippi. This variety is very resistant to bolting under field conditions. Growers who wish to extend their harvesting season should make successive plantings of this variety. Early Round Dutch and Glory of Enkhuizen produced the highest yields for the four-year average. Early Glory produces a satisfactory yield. This variety appears to be well adapted to hill land. Bonanza matures later than Round Dutch. Resistant Glory produces large heads and tends to be variable in yield from season to season. Greenback is well adapted to local growing conditions. This variety is slightly earlier than Round Dutch. Greenback has dark green foliage and makes a compact round head.

Cabbage are harvested for the fresh market when the heads are firm. When harvesting, two or three outside wrapper leaves are cut with each head. Cabbage are usually sold by the ton or in 50-pound sacks. The fresh market prefers a cabbage with an average head weight of 2.0 to 2.5 pounds. To obtain the desirable weight, large-headed varieties should be spaced close together in the row (10 to 12 inches apart) and grown on hill land or light soils. The small-headed varieties should be grown on bottom land or heavy soils.

Table 1. Cabbage variety trials 1956-59.

Variety	Avg. no. days to 1st harvest	Av. head wt., lbs.	Av. yield tons per acre
Regular Round Dutch	97	2.2	10.2
Early Glory	97	3.1	11.2
Greenback	85	2.3	10.3
Glory of Enkhuizen	97	3.5	12.2
Early Round Dutch Large Strain	97	3.0	14.0
Resistand Glory	97	3.4	11.9
Bonanza	100	2.8	8.7

Broccoli: The leading broccoli varieties for spring and fall production are Green Mountain and Texas 107. Broccoli will usually produce 2 to 4 tons per acre. Table 2 presents yield data of several cauliflower and broccoli varieties grown in the fall.

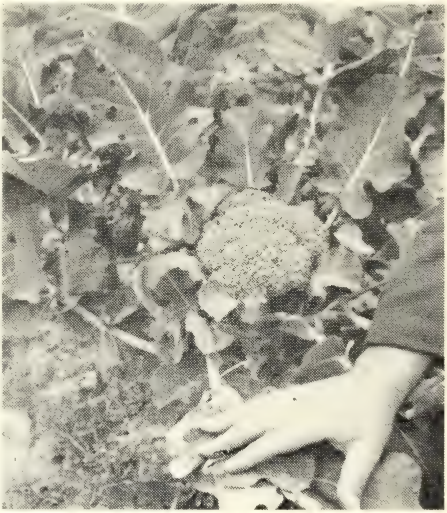

Figure 1. A terminal head of broccoli ready for harvest.

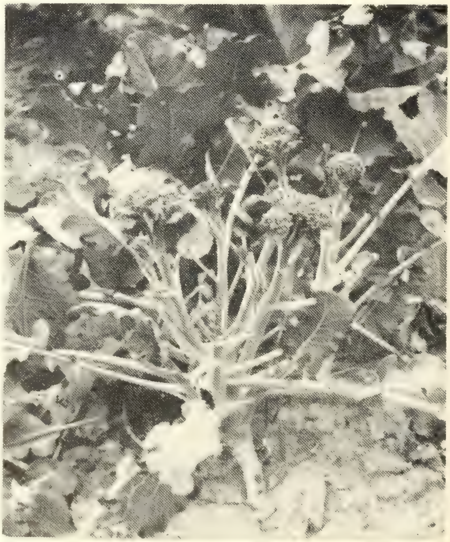

Figure 2. Lateral shoots of broccoli. Terminal buds harvested at the peak of maturity.

Table 2. Broccoli and cauliflower yield data.

Varieties	Tons per acre
Broccoli	
Green Mountain	2.22
Texas 107	2.15
Medium Strain	1.90
Early Medium	1.85
Cauliflower	
Snowball-Y	4.32
Snowball-X	4.14
Snowball-M	3.25
Snowball-E	2.22

Unopened flower buds of broccoli make up the edible portion. The central inflorescense with approximately six inches of stem is harvested before any of the flowers begin to open. As the lateral shoots develop, these are harvested with 4 to 6 inches of stem. The lateral shoots produce a continuous harvest for several weeks.

Broccoli that fits into the U. S. Fancy classification has the following characteristics. Each bunch shall be free from decay, over-maturity, discoloration of buds and leaves, free of dirt and other foreign matter, and free of disease and insect injury. The bud clusters in each bunch shall be generally compact. Each bunch shall be trimmed and neatly tied. The minimum diameter of each stalk shall be two and one-half inches unless otherwise specified. The length of each stalk shall not be less than six inches or more than eight and one-half inches.

Cauliflower: Tests during the spring and fall indicate the two leading varieties of cauliflower are Snowball-Y and Snowball-M. Cauliflower will produce from 4 to 7 tons per acre. In order to produce a high quality pure white curd it is necessary to exclude the sunlight. Three to four jacket leaves should be tied around the curd when about two inches in diameter. The curd will be ready to harvest in 4 to 8 days. High quality cauliflower should be harvested when the curds reach a marketable size of 4 to 8 inches. Snowball-Y, Snowball-M, and Snowball-E tend to be of equal quality if each is harvested at the proper stage of maturity.

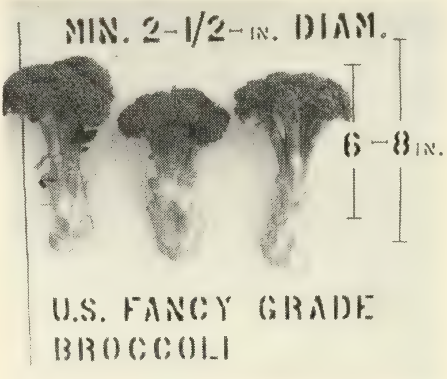

Figure 3. U. S. Fancy broccoli. Terminal buds harvested at the peak of maturity.

U. S. No. 1 cauliflower must meet the following specifications. The curds should be compact and show no discoloration. They should be free from decay and insect damage. The jacket leaves should be green, free from disease and insect damage and well trimmed. Unless otherwise specified curds should not be less than four inches in diameter, free from riceness and hollow stem.

Disease and Insect Control

Downy Mildew or Blue Mold (Peronospora parasitica). This is principally a disease of seedlings. During unfavorable weather conditions downy mildew can be recognized on seedlings by the yellow appearance of the leaves and the violet downy growth on the lower surface of infected leaves, with eventual shriveling of infected leaves. Plants that survive seedling infection are usually stunted. On older plants the disease can be recognized by flecking or rusting of older leaves which are completely killed.

Control: Spraying or dusting will control downy mildew if the program is started soon after germination and continued while plants are in the seedbed. For mild infection treat at 7-day intervals For severe infection treat twice a week.

Dust tends to be more effective in controlling downy mildew. Apply dust when

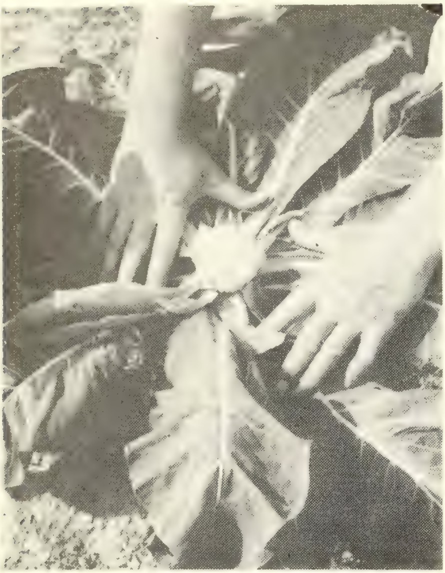

Figure 4. Cauliflower curd ready for blanching.

plants are wet with dew. For effective control good coverage must be obtained on the upper and lower leaf surface. Use a good duster.

Dust Mixture: Spergon Wettable — 6 parts or 5 ounces. Clay Talc — 94 parts or 4 pounds 11 ounces. A five-pound mixture will adequately cover one coldframe.

Spray: For spraying to be effective the seedlings should be dry and thorough coverage should be obtained. Spergon Wettable 3¼ ounces, soap powder ½ ounce, or sticker spreader (follow directions on container), water 5 gallons. This mixture will adequately cover an average size coldframe. Continue treatment until three weeks before transplanting.

Damping-off (caused by soil fungi complex). This is a common seedbed or seedling disease. The early symptoms are wilting of the seed leaves. The stem is girdled at or below the soil line; following this stage of infection, the plants fall over. Damping-off occurs in low, poorly drained areas of the seedbed.

Control: Seedbed sterilization (see seedbed treatments). Seed treated with chemicals — Arasan or Tersan-75, mix ½ teaspoon per pound of seed. Good seedbed drainage and aeration will aid in controlling damping-off.

Blackrot (Xanthomonas campestris). This disease is very destructive to maturing cabbage and cauliflower. The bacteria are seed borne. Under certain conditions the bacterium can live in the soil from season to season. It is easily spread by moving through field when the plants are wet. The conspicuous symptom of blackrot on cabbage is the firing of leaf margins. The symptoms on cauliflower vary from wilting to spotting and eventually shedding of the leaves. Blackrot is a warm weather disease and is evident on cabbage when the plants are forming heads. Often diseased cabbage wilt and die. This is a vascular disease and if stems of diseased plants are cut, blackened strands may be seen in the diseased stem.

Control: Blackrot may be controlled by practicing all of the following recommend-

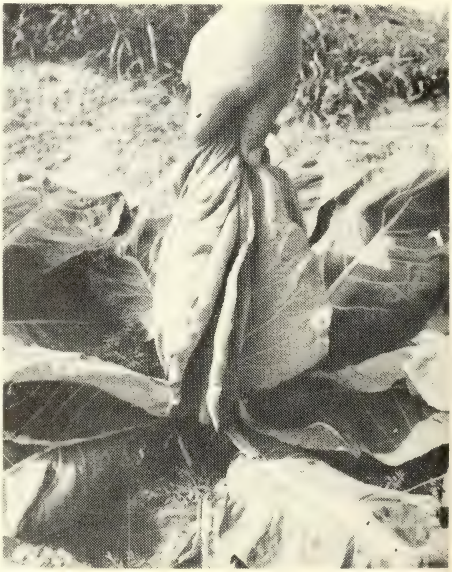

Figure 5. Jacket leaves of cauliflower pulled around the young curd for blanching.

ations:

1. Seed treatment with hot water.
2. Use of clean seedbed each year.
3. At least a 2-year crop rotation.
4. Keep out of fields when plants are wet. Cultivate when the plants are dry.

Hot Water Treatment of Seed: Do not treat old seed or seed that have previously been coated or treated with chemicals. Place seed to be treated in a cloth bag and soak in water at a temperature of 122° F. Soak cabbage 25 minutes, and cauliflower 18 minutes. Constantly agitate the water and maintain the temperature level during seed soaking period. After treatment place the seed in cold water so they may cool quickly. The seed may be planted immediately or dried and planted later.

Steps in Coldframe Preparation

1. Select a well drained site, usually on the protected side of a hill.
2. When preparing the soil, pulverize and add 6-8-8 fertilizer, or equivalent, at rate of 50 pounds per 10 x 60 foot coldframe. Broadcast fertilizer during last stages of soil preparation.
3. The soil surface should be raked until even and smooth (no low places left). This will make for good surface drainage and aid in reducing disease problems.
4. Construct coldframe out of lumber or any suitable material. Use white muslin cloth or plastic for cover.
5. Temporary soil sterilants may be used to sterilize the soil for grass and weeds, soil disease and soil insect control.

Seedbed Preparation and Chemical Application

Soil in old hotbeds and coldframes may be used for more than one year if sterilized after each season or after the removal of each crop of plants. Certain practices must be carefully followed for best results.

1. The soil should be finely pulverized and contain enough moisture for seed germination. All operations for making a plant bed except seeding should be completed before applying the treatment.

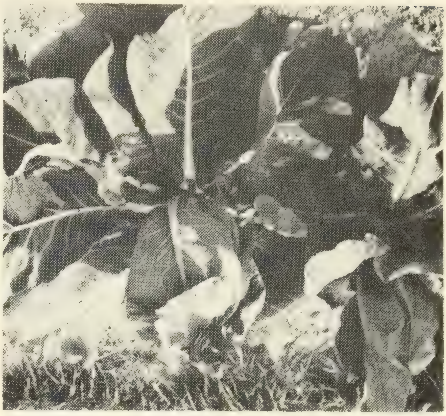

Figure 6. Jacket leaves of cauliflower tied in place. The curd will be ready for harvest in 4 to 8 days.

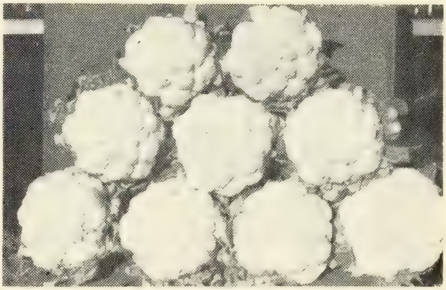

Figure 7. Mature cauliflower trimmed and ready for market.

2. For even distribution and penetration the seedbed should be thoroughly watered immediately after application of the soil sterilant.
3. Any equipment suitable for drenching may be used, for example, a greenhouse sprinkler can. When applying dust, it should be evenly distributed over the surface and worked into the top two inches of soil.
4. After sterilant application and just prior to planting, break the crust and plant seed. Cover lightly and water if necessary.

Application: Bedrench or Vapam — Apply 1.5 quarts of either for 100 square feet of seedbed area. Dilute with enough water (2 to 4 gallons) to evenly cover the soil surface. Thoroughly water the seedbed immediately after application.

Mylone W-50 — Apply 1.5 pounds per 100 square feet of seedbed area. Mix with enough water (2 to 4 gallons) to cover the soil surface evenly.

Mylone as a dry powder — Distribute evenly and work into the top 2 to 4 inches of soil 1.5 pounds per 100 square feet of seedbed area. Water the seedbed thoroughly immediately after application of Mylone W-50 or Mylone dry.

Wait 15 to 20 days before planting seed when Bedrench, Vapam or Mylone is used.

Insect Control: Timely insect control plays a vital part in producing high quality broccoli, cauliflower and cabbage.

Application of Insecticides

The application of insecticides is very important. Get complete plant coverage and maintain good insect control. Old established infestations of insects are hard to control. Apply insecticides to the top and underside of leaves. If as much as one-half inch of rainfall occurs within 24 hours after application repeat immediately.

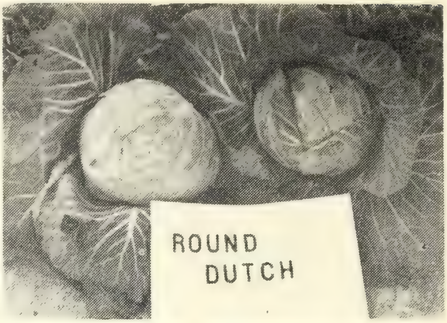

Figure 8. Mature heads of Round Dutch cabbage. Note the round head type and large, close folding wrapper leaves.

Dust when the air is still, usually in the late afternoon or early morning.

Spray: The amount of spray mixture (insecticide and water) per acre varies with most spray equipment and the size of plants. The important point is to use enough water with a given amount of insecticide to get good coverage. In many cases this takes from 35 to 100 gallons of water per acre.

The insecticide program in Table 3 will control insects attacking cauliflower, broccoli, and cabbage. If followed as directed, it will meet the tolerance limits of the Federal and State Pesticide Regulations.

Table 3. Insect control recommendations.

Insects	Insecticide	Rate per acre	Method of application
Aphids	1% parathion	10-20 lbs.	Dust[1]
	4% malathion	10-20 lbs.	Dust
	Parathion	¼-½ lb.	Spray[2]
	Malathion	½-1 lb.	Spray
	Demeton	½-1 pt.	Spray
Cutworm and Seedcorn Maggot	20% toxaphene	10-20 lbs.	Dust
	Toxaphene	2-3 lbs.	Spray
	Do not apply after young heads begin to form.		
(A) Early Season Control, Cabbage Looper and Imported Cabbage Worms	2% endrin	10-20 lbs.	Dust
	20% toxaphene	10-20 lbs.	Dust
	1% parathion	10-20 lbs.	Dust
	Endrin	¼ lb.	Spray
	Toxaphene	2-3 lbs.	Spray
	Parathion	¼-½ lb.	Spray
	May apply up to harvest.		
(B) Late Season Control, before harvest	2% phosdrin	10-20 lbs.	Dust
	100% ryania	10-20 lbs.	Dust
	3% rotenone	10-20 lbs.	Dust
	Phosdrin	¼-½ lb.	Spray
	50% ryania	10-20 lbs.	Spray
	5% rotenone	10-20 lbs.	Spray

[1] Dust—10 to 20 pounds per acre for good coverage.

[2] Spray—35 to 100 gal. water per acre for good coverage.

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Trends in the Adoption of Recommended Farm Practices

Alcorn County, Mississippi, 1954-1957

Mississippi State University
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director

STATE COLLEGE MISSISSIPPI

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TRENDS IN THE ADOPTION OF RECOMMENDED FARM PRACTICES

Alcorn County, Mississippi, 1954-1957

By Leslie J. Silverman and Wilfrid C. Bailey

Adoption of agricultural practices has been a major focus of a survey in Alcorn County, Mississippi.[1] In 1954 a group of 161 farmers were interviewed regarding their 1954 crop year. It was found that nearly all of them had heard of the twelve practices included in the study, but many did not approve of some of them. Although some farmers had heard of a practice and approved of it, they did not necessarily use it.[2] These same farmers were re-interviewed in 1958 about their 1957 crop year. Of the original 161 a total of 107 were still farming.[3] Comparison of this panel of 107 farmers for the two periods yields important information on trends in the adoption of farm practices.

Adoption Trend Is Up

The use of twelve farm practices in 1957 was compared with 1954. Only those practices that applied to enterprises carried out in both years were counted. For the 107 farmers in the study a total of 1020 practices applied. The trend in the use of the recommended farm practices was up:

Recommended practices used, 1957	68.1%
Recommended practices used, 1954	59.2%
Increase, 1957-1954	8.9%

Because the study included records of the performance of individual farmers for both years it was possible to examine the trend in greater detail. The increase of about 9 percent was the net result of both adding and dropping practices:

	Number	Percent
Practices added	178	17.5
Practices dropped	88	8.6
Net Increase	90	8.9

Thus, while the trend was up, it was a process working in both directions. Farmers dropped one practice for every two they added.

While farmers were adding and dropping some practices, they were stable on the use of most. Some practices were followed both years or not used either year.

	Number	Percent
Followed both years	516	50.6
Changed, 1954-1957	266	26.1
Not followed either year	238	23.3
	1020	100.0

From this is can be seen that about one-half of the practices were used and unchanged, about one quarter were changed by either adding or dropping, and slightly less than one in four were not followed either year. Looking at these figures from another way, although only two-thirds of the practices were being followed in 1957, over three-quarters (76.7 percent) of the recommended practices had been tried during one or both sample years.

Trends Differ Among the Twelve Practices

Combining the data for all twelve of the practices might imply that the trends for each practice were similar. Such was not the case. Table 1 reveals that the practices showed considerable variation. There were important

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[1] This report is part of a larger study conducted in Alcorn County, Mississippi, by the Department of Sociology and Rural Life of the Mississippi Agricultural Experiment Station and the Tennessee Valley Authority in cooperation with the Mississippi Extension Service and the Alcorn County Community Development Council. See Wilfrid C. Bailey, **Mississippi Community Education Experiment: Final Report**, Prelminary Reports in Sociology and Rural Life, No. 7, 1959.

[2] Harold F. Kaufman and Herbert A. Aurbach, "Knowledge and Use of Recommended Farm Practices," **Mississippi Farm Research**, Vol. 19, No. 6 (June), 1956.

[3] Andrew W. Baird and Wilfrid C. Bailey, **Farmers Moving Out of Agriculture**, Mississippi Agricultural Experiment Station Bulletin 568, 1958.

Table 1: Trends for the adoption of each of twelve recommended farm practices, 1954 and 1957

Practice	No. 1954[1]	No. 1957[1]	Did not have relevant enterprise 1954	Did not have relevant enterprise 1957	Adoption 1954[2]	Turnover[2] Added	- Dropped	= Total	Net Change	Adoption 1957[3]
Sidedress corn	106	107	0.9%	0.0%	81.1%	7.5%	18.9%	26.4%	-11.4%	69.2%
Thick space corn	106	107	0.9%	0.0%	65.1%	16.0%	11.3%	27.3%	4.7%	69.2%
Hybrid seed corn	106	107	0.9%	0.0%	37.7%	22.6%	4.7%	27.3%	17.9%	55.1%
Certified cotton seed	99	85	7.5%	20.6%	79.8%	11.1%	6.1%	17.2%	5.0%	85.9%
Poison cotton four times a year	99	85	7.5%	20.6%	49.5%	33.3%	1.0%	34.3%	32.3%	87.1%
Warfarin	107	107	0.0%	0.0%	47.7%	42.1%	2.8%	44.9%	39.3%	86.9%
Cull Trees	80	73	25.2%	31.8%	35.0%	23.8%	7.5%	31.3%	16.3%	60.3%
Mow Pastures	100	103	6.5%	3.7%	53.0%	13.0%	13.0%	26.0%	0.0%	52.4%
Soil test within five years	107	107	0.0%	0.0%	35.5%	5.6%	5.6%	11.2%	0.0%	35.5%
Use more fertilizer on better soils	107	107	0.0%	0.0%	59.8%	13.1%	16.8%	29.9%	-3.7%	56.1%
Buy fertilizer by plant food analysis	107	107	0.0%	0.0%	76.6%	15.9%	5.6%	21.5%	10.3%	86.9%
Keep written records	107	107	0.0%	0.0%	19.6%	23.4%	3.7%	27.1%	19.7%	39.3%

[1] The total sample for both years was 107. These are the numbers in the respective years who had the relevant enterprise.

[2] Percentages based upon 1954 sample size for each enterprise. The average scores for those who dropped out of farming between 1954 and 1957 differed from that of the 107 who stayed in farming. The percentages used in this report may not be the same as the previously published figures based on all 161 farmers interviewed in 1954.

[3] Percentages based upon 1957 sample size for each enterprise. When 1954 and 1957 sample sizes differ, the sum of the 1954 adoption plus the net change will not be equal to the 1957 adoption.

differences not only in the number of farmers using a particular practice in either year but also in the amount of adding or dropping. In 1954 the percent using a practice ranged from 81.1 percent sidedressing corn to a low of 19.6 percent keeping written records. In 1957 the range was from 87.1 percent poisoning cotton four times to 35.5 percent for soil testing. The net change varied from a loss of 11.4 percent for sidedressing corn to a gain of 39.3 percent in the use of warfarin type rat poisons.

Not only did the practices differ in net change but the amount of adding or dropping varied. There was both adding and dropping of each of the twelve practices. The turnover rates ranged from 11.2 percent to 44.9 percent for warfarin. Net change resulted from the combination of adding and dropping.

There can be an important difference between the net change and the amount of change for a given practice. The practice of mowing pastures showed no net change. In reality, 26 percent of the farmers changed in respect to this practice. However, those adding the practice were balanced by those dropping it. Other practices showed high rates of change but had only a small net change. Similarly some practices with the same total change had very different net changes. More than one quarter of the farmers changed in their use of thick spacing of corn and hybrid corn seed. Although both had a total change of 27.3 percent, thick spacing had a net increase of only 4.7 percent while the use of hybrid corn increased 17.9 percent.

At this time it is not possible to fully explain the differences in the changes between the twelve recommended practices. One possible influence toward change could have been the various education programs carried out in the county between the two survey periods. In 1957 four practices had over 85 percent use. All four have been associated with special educational efforts. The two cotton practices have been stressed by the County Agent to improve income from cotton in the face of acreage reductions. The community development clubs had special projects to obtain community-wide use of warfarin. The Assistant County Agent planned and trained a 4-H Club demonstration team on theme of buying fertilizer by plant food analysis. This team won top honors in the state and presented its demonstration to nearly every organized farm group in the county.[4]

Analysis of the three corn practices suggests that the adoption of a practice may be linked with the use or non-use of other practices. In Table 2 the combination of the three corn practices of sidedressing (or not sidedressing), thick spacing (or wide spacing), and hybrid seed (or open pollinated seed) are arranged in order of expected yield, all other things being equal. The largest expected yield is at the top. Essentially, 1957, 85 percent of the sample used or did not use the three practices in understandable, if not fully recommended combinations. Of the remaining 15 percent, weather conditions, factors in their personal situation, or idiosyncrasies may account for their seemingly not understandable combinations of practices such as thick spacing of hybrid seed without sidedressing.

Panel analysis of the changes made by the individual farmers from 1954 to 1957 is presented in the cross-tabulation in Table 3. The numbers in bold type on the diagonal represent no change from 1954 to 1957. The numbers above and to the right of the diagonal indicate changes that

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[4] Andrew W. Baird and Wilfrid C. Bailey, **Community Development Clubs in Alcorn County, Mississippi**; Mississippi Agricultural Experiment Station Bulletn 597, May 1960.

Table 2: Distribution of three corn practices used in 1954 and 1957

Combinations of corn practices[1]			Proportion who adopted:	
			1954	1957
			(Percent)	
Sidedress	Thick-space	Hybrid seed	34	42
Sidedress	No thick-space	Hybrid seed	3	5
Sidedress	Thick-space	Open pollinated seed	25	13
Sidedress	No thick-space	Open pollinated seed	18	11
No sidedress	No thick-space	Hybrid seed	0	2
No sidedress	No thick-space	Open pollinated seed	14	12
No sidedress	Thick-space	Hybrid seed	2	7
No sidedress	Thick-space	Open pollinated seed	4	8
		Totals	100	100

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[1] Arranged in order of expected yield, highest at the top.

Table 3: Percent of total sample following each combination of practices

	1954									
1957	1. Sidedress, thick-space, hybrid seed	2. Sidedress, no thick-space, hybrid seed	3. Sidedress, thick-space, open pollinated seed	4. Sidedress, no thick-space, open pollinated seed	5. No sidedress, no thick-space, hybrid seed	6. No sidedress, no thick-space, open pollinated seed	7. No sidedress, thick-space, hybrid seed	8. No sidedress, thick-space, open pollinated seed	Totals (Percent)	Totals (Number)
1. Sidedress, thick-space, hybrid seed	26.4	2.8	8.5	2.8	0	0.9	0	0.9	42.3	(45)
2. Sidedress, no thick-space, hybrid seed	0.9	0	2.8	0.9	0	0	0	0	4.6	(5)
3. Sidedress, thick-space, open pollinated seed	1.9	0	4.7	3.8	0	1.9	0	0.9	13.2	(13)
4. Sidedress, no thick-space, open pollinated seed	0	0	3.8	3.8	0	3.8	0	0	10.4	(11)
5. No sidedress, no thick-space, hybrid seed	0	0	0	0	0	0.9	0.9	0	1.8	(2)
6. No sidedress, no thick-space, open pollinated seed	1.9	0	0.9	3.8	0	4.7	0	0.9	11.3	(11)
7. No sidedress, thick-space, hybrid seed	1.9	0	1.9	0.9	0	0	0.9	0.9	6.5	(7)
8. No sidedress, thick-space, open pollinated seed	0.9	0	2.8	1.9	0	1.9	0	0.9	8.4	(8)
Totals (Percent)	33.9	2.8	25.4	17.9	0	14.1	1.8	3.6		
Totals (Number)	(36)	(3)	(27)	(19)	(0)	(15)	(2)	(4)		(106)

would be expected to have increased yields. Numbers below and to the left of the diagonal are for changes that would be expected to have reduced yields. The table can be summarized as follows:

Changes in direction of increased yield	34%
Made no change	41%
Changes in direction of decreased yield	25%

Part of the improvement in the practice of culling trees can be accounted for by the nature of the practices of farmers adding and dropping the enterprise. Only those having ten or more acres of woodland, not including woodland pasture were counted. Of the 14 who dropped the enterprise, between 1954 and 1957, all did not cull their trees in 1954. Of the 7 who added forestry between 1954 and 1957, 6 culled their trees in 1957.

Most Farmers Change

Examination of the data shows that change was characteristic of most farmers. (Table 4) Only 8 out of the 107 neither added nor dropped a practice between 1954 and 1957. Six of those who made no change followed all applicable practices both years. The average number of changes per farmer was 2.5. In general, those who had the most to add, added the most. This can be seen in Table 5.

Table 5: Relation between the number of practices added in 1957 and the number of practices that could have been added.

Number of practices that could be added	Number of cases	Average number added
0	11	---
1	4	0.5
2	13	1.1
3	19	1.4
4	19	1.5
5	16	2.1
	16	2.4
7 or more	9	3.4

However, the opposite was not true. Those with the greatest number of practices in 1954 did not drop the greatest number. (Table 6).

Table 6: Relation between the number of practices dropped and the number of practices followed in 1954.

Number of practices that could be dropped	Number of cases	Average number dropped
9-11	14	0.4
7- 8	25	1.1
5- 6	34	0.9
3- 4	21	0.8
1- 2	13	0.8

The farmers following relatively more practices did not drop any more practices than did the farmers following relatively few practices. This is indicative of the general trend upward in the adoption of recommended

Table 4: Relationship between number of changes and contribution to total change

Number of changes (either or both added or dropped)	Percentage of sample making this number of changes	Percentage of turnover accounted for by sample proportion	Number of cases
0	7.5	0	8
1	20.6	8.3	22
2	26.1	21.1	28
3	21.5	26.0	23
4	16.8	27.2	18
5 or more	7.5	17.4	8
Totals	100.0	100.0	107

practices. The farmers were adding more than they were dropping. This can be seen in Table 7.

Table 7: Relation between the number of practices added and the number of practices dropped.

Number added	Average number dropped	Number of cases
0	0.9	24
1	0.9	29
2	0.8	31
3	0.9	14
4 or more	0.4	9

Implications of These Findings

While one should be cautious about applying to the whole of Mississippi the observations on changes made by 107 farmers in the use of twelve practices, certain implications are suggested by these data.

(1) Although the casual observer might think that from year to year little change is taking place, this study shows that in a three-year period considerable change did take place. While there was a tendency for those who added the most practices to account for a disproportionate amount of the change, very few farmers neither added nor dropped practices. Some change characterized almost all the individuals in the sample.

Improvement in the use of recommended practices is the net result of both adding and dropping. Although the net increase was less than ten percent, the evidence suggests that the impact is even greater. Adding and dropping may indicate a period of changeability while many farmers are learning the value of practices and the techniques for best using them in their farm enterprise.

(2) The adoption and continued use of individual recommended farm practices are not isolated acts. They are related to other factors such as the combining several practices into a workable unit. This was illustrated by the case of corn where adoption of one practice without another could reduce rather than increase expected yields.

(3) The net gains by certain of the farming practices suggests that the educational activities of various agricultural agencies are having a noticeable impact.

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Size of Trade Center And Development Programs

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY LEVECK, Director

STATE COLLEGE MISSISSIPPI

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JUL 29 1961

IMPLICATIONS

If participation in development programs and population growth are valid indices of vitality, then most of the population centers in Mississippi do have a future. This is true of the rural centers (under 2,500) as well as of the larger places. Although participation in the Hometown Program and population growth were related to size, a relatively large number of rural centers showed decided potentiality for growth and development. This was especially true for places over 500 population.

The potentiality of the smaller centers for development as well as their relatively larger numbers in Mississippi challenges research, education, and action programs. Traditional city planning programs have not generally been aimed at places under 2,500, although they comprise four-fifths of all incorporated places in the state. By far the largest number of towns with development potential — organization, leadership, and growing populations — fall in this population class.

A careful study of factors making for development of hamlets and small towns is greatly needed. For example, are their futures largely as centers of production, of residence, or both?

Many industrial specialists would say that factories will settle in few of the smaller places, although some programs of industrialization, such as the one in Lee County, have promoted this type of development.

The small center may have a greater future as a place of residence than of production, especially if it stresses quality living. Certainly the role of the small center, both as a place to live and to make a living, should be studied more carefully before it is abandoned by community development leaders as hopeless.

SIZE OF TRADE CENTER AND DEVELOPMENT PROGRAMS

By HAROLD F. KAUFMAN and LUCY W. COLE

Do rural population centers — those under 2,500 — have a future? This report attempts to provide some information in answering this question by a look at the population changes in Mississippi trade centers (incorporated towns) and at their participation in a development activity. The specific activity analyzed is the Hometown Development Program, which was conducted during the three-year period 1957-59.

The two major objectives of the analysis are to relate the size of the center (1) to participation in the Hometown Program, and (2) to the nature of the involvement.

As necessary background for this analysis, the population trends of population centers are noted and pertinent characteristics of the Hometown Development Program are described. This study is also to be seen in the context of rapid changes and adjustments in agriculture and in the perspective of community and rural development programs to improve the level of life of farm and other rural people.

Growth Related to Size

The larger the center, the more likely it was to gain population. This was true for the South and for the United States as a whole.[1] In Mississippi 75 percent of the 52 places of over 1,000 population in 1900 had either gained population or held their own during the half century 1900-1950, while only 37 percent of the 240 places under 1,000 in population had fared as well.[2]

The same trend continued in the 1950-60 decade, as is shown in Table 1. Over two-fifths of all the centers gained 10 percent or more population during the 1950-60 decade. Over two-thirds of the centers over 1,000 had such a gain. Even three-fourths of those in the population class 501-1,000 either remained relatively stable or showed an appreciable increase. Only in the very small centers, those un-

Table 1. Incorporated places in Mississippi in 1950 classified by population growth during 1950-60 decade.

Population 1950	Total No. of towns	Percent of incorporated places with following population changes: Decrease of 10%	10% increase-10% decrease	Increase of over 10%
All towns	278	24	33	43
500 and under*	97	50	30	20
501-1,000	64	23	44	33
1,001-2,500	64	3	34	63
2,501-5,000	25	4	32	64
5,001-10,000	13	0	23	77
Over 10,000	15	0	13	87

*Seven towns were not reported in the 1960 census, and four towns reported in 1960 that were not present in 1950, for a total of 275 in 1960.

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*Acknowledgment is made to the Mississippi Economic Council and to the scores of communities participating in the Hometown Development Program for the information on which a part of this study is based.

[1] Edmund deS. Brunner, "Village Growth 1940-50," **Rural Sociology,** June 1951, and "The Small Village: 1940-50," **Rural Sociology,** June 1952.

[2] A. Alexander Fanelli and Harald A. Pedersen, **Growth Trends of Mississippi Population Centers, 1900-1950,** Mississippi State College, Social Science Research Center, Community Series No. 10, July 1956.

der 500, was there a decided decrease in population. Half of these centers decreased 10 percent or more in population during the decade, while only one-fifth of them gained over 10 percent.

Most of the small towns of America were established and grew as trade and service centers for the surrounding farm population. Two major factors in the decline of small agricultural trade centers over the last several decades have been (1) the increased competition of larger centers with improved transportation and communication, and (2) the decline in the farm population. Small centers have lost such services as retail stores, post offices, and schools. The number of school districts in Mississippi has declined from 4,211 in 1948 to 151 in 1958. The number of attendance units has likewise greatly declined.

The farm population of the state and region is rapidly moving out of agriculture. Mississippi is estimated to have lost a half million from its farms in the period 1940-1954. This is equal to more than a third of the farm population at the earlier period.[3] The number of farms and farm operators likewise declined during this period. If anything, the decline was even more precipitate for the period 1954-59. During this period, Mississippi lost over 66,000 farms, or nearly 31 percent of the 216,000 farms enumerated in 1954.

Two major factors in the shift out of agriculture have been (1) improved technology, which has allowed for greater production per man and the need for fewer workers, and (2) the desire for higher incomes on the part of the people engaged in agriculture. Thus if the population in a given area is not to decline appreciably, nonfarm employment must be supplied. For a number of years Mississippi leadership has been aware of this situation. Efforts to meet it are characterized by the work of the Agricultural and Industrial Board through its Balance Agriculture with Industry program. The purpose of this program has been to help the various communities in the state to secure industry in order to maintain employment.

The Hometown Development Program

Many programs have arisen in the South since the end of World War II, organized at the community level to increase the opportunities for making a living as well as to improve the quality of living. Some of these programs have been organized primarily around trade centers, like the Hometown Development program, and others have focused chiefly on the open country neighborhoods.[4]

Although increasing nonagricultural employment has been a major objective of all trade center programs, they have also expressed the philosophy that factories are not likely to locate in communities which do not have a high level of governmental, educational, and other services. Thus, the development programs have been broad in their interests and community-wide in terms of groups and agencies involved.

A typical trade center program was the Hometown Development Program which was organized by the State Chamber of Commerce (the Mississippi Economic Council) in the mid-fifties. The program was based on careful study of similar work in other Southern states and had the support of over 30 business and manufacturing corporations and state agencies. It was continued for three consecutive calendar years, 1957, 1958, and 1959.[5]

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[3] Harald A. Pedersen, "Migration from Mississippi," **Mississippi Farm Research,** Vol. 19, No. 5, May 1956, p. 6.

[4] Harold F. Kaufman, **Community Development Programs in the Southeast,** Social Science Research Center, Community Studies No. 9, June 1956; and A. W. Baird and W. C. Bailey, **Community Development Clubs in Alcorn County, Mississippi,** Mississippi Agricultural Experiment

Formal entry was made into the program early in the year, and a final report was submitted at the end of the year. All reports were reviewed by a panel of out-of-state judges. Varying from year to year, from 22 to 34 "finalists" were chosen and cash awards were given to half this number. Awards the first year were divided among three population class centers, with breaks at 2,500 and 10,000 population. The last two years a fourth class was created with a break at 1,000 population.

"One organization," preferably the "Chamber of Commerce or similar community-wide organization," was permitted to enter "any incorporated community." "Rural improvement and agricultural development projects" were "not only eligible but sponsors" were "encouraged to enter them." In entering the annual statewide program, a community listed the projects it planned to work on during the year. No limit was placed on the number of projects entered but during the two years of the contest a community to enter must have had a beautification project.

Three aspects of developing a program and 15 areas of subject matter content were suggested. The contest guide suggested that the community reports be made in terms of (1) analysis of community needs and problems, (2) organization and plan of action, and (3) record of accomplishments. The 15 project categories were agriculture, beautification, business activities, county government, education, family living, health and sanitation, industry, municpal government, population and manpower, recreation and culture, spiritual life, tourists, transportation and communication, and youth.

Extent of Program Participation

The Hometown Development Program was broadly based so as to meet the interests and needs of population centers of all sizes. A survey made before the program was launched indicated that residents of small as well as large population centers recognized the need for action.[6] Thus the question follows as to the relative response among population centers of the various sizes. Nearly two-thirds, or 175 of 278 incorporated places, enrolled in the Hometown Program for at least one year. The number of towns enrolled and the number reporting for each of the three years were as follows:

	Enrolling	**Reporting**
1957	126	114
1958	153	125
1959	118	89

The participation of places by size in the Hometown Program is shown in Table 2. The most important findings in this table are the populations at which participation increases or decreases. The most important division is at 500 population. Lesser divisons are at 1,000 and 10,000. The findings of this table confirm the observations of community development specialists that programs such as the Hometown activity are most adaptable to places in the general population range of 1,000-10,000.

Nature of Program Participation

Decided divisions are seen among places of various sizes concerning the organizations sponsoring the Hometown Program. The Chamber of Commerce was the major sponsor for places over 2,500, while places 500 and under had a great variety of sponsors. Civic groups were the most common sponsor for the population group

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[5] For details see **The 1957 Mississippi Hometown Development Program, The 1958 Mississippi Hometown Development Program, The 1959 Mississippi Hometown Development Program,** and **Planned Development: Basic Steps for Mississippi Towns, Areas and Counties** (January 1959), all published by the Mississippi Economic Council, Jackson, Mississippi.

[6] A. Alexander Fanelli, **Needs and Problems of Mississippi Communities,** Mississippi State College, Social Science Research Center, Community Series No. 5, March 1955.

Table 2. Incorporated towns enrolled and reporting in the Mississippi Hometown Development Program 1957-1959.

Population 1950	Total No. of towns	Percent Enroll one or more years	Percent Enrolled and reporting two years	Percent Enrolled and reporting three years
All sizes	278	63	40	22
500 and under	97	23	11	5
501 to 1,000	64	80	47	20
1,001 to 2,500	64	84	53	33
2,501 to 5,000	25	92	76	36
5,001 to 10,000	13	100	62	46
Over 10,000	15	80	60	40

501-1,000. Town boards were prominent sponsors in the smaller centers. Programs sponsored by town boards, however, were less successful than the average.

Although a program in any given community had only one sponsor, in most cases a number of organizations cooperated in carrying it out. Organizations were classified by type and by size of population center. Civic groups were found more frequently to participate in development work than any other type of organization. They were active in over four-fifths of the programs in places between 501 and 10,000 in population. City government also was relatively active in all sizes of centers. Chambers of commerce were active in the larger centers, as in a number of the smaller ones such organizations did not exist. The church cooperated in nearly half of the programs in centers of 2,500 and under, but none of the programs in centers of over 10,000. In addition to the church, schools and agencies of the Agricultural Extension Service were prominent in the smaller places.

In the 1958 program, 125 centers made reports. These reports were analyzed concerning the extent to which effective community organizational procedures were followed.[7] The 22 finalists of the 1958 program were compared with the 103 other communities as to the procedures employed. In general, the finalists were more likely to have the following organizational characteristics:

1. Many groups were involved in planning and carrying out projects.

2. A large number and variety of projects were initiated.

3. Widespread publicity was used and a number of special community-wide activities held.

4. Agencies outside the community were utilized for professional services.

5. Frequent follow-up meetings were held and progress reports made.

Smaller towns were often handicapped by not having a newspaper to serve as the publicity medium. However, one enterprising community under 500 mimeographed a monthly newsletter describing the progress of the program. The size of place seemed to influence the type of community-wide program. For example, community recreation for money-making purposes and joint religious activities was much more typical of the smaller places, while the larger places were more likely to have special drives, fairs, and historical celebrations.

A study of reports of 28 communities for the three-year period indicated that towns over 10,000 tended as time passed to have fewer and fewer groups involved in the program. There was a tendency to turn over to one organization, such as the chamber of commerce, the responsibility for the development activity. This is further evidence to support the general observation that as population centers grow larger, widespread participation of many different groups becomes more and more difficult. Programs, even though they have widespread benefit, become more and more the concern of special groups.

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[7] These are procedures which community organization specialists regard as the more effective ones. These are discussed in detail in Lucy W. Cole's **A Mississippi Program in Trade Center Development,** Mississippi Agricultural Experiment Station Preliminary Report in Sociology & Rural Life No. 17, April 1961.

Agriculture and Other Programs

Farm people appeared to be active in a relatively large number of programs. Over half of the communities judged as finalists in the 1958 program were reported to be involved in agriculture and trade center activities. During this year trade area programs were sponsored by all centers over 10,000, nearly half of those 2,500-10,000, but less than a third of those 2,500 and under. It is significant that the most outstanding program over the three-year period in a center under 500 had agricultural and trade area projects.

As would be expected, agricultural agencies, especially the Agricultural Extension Service, were more likely to be centered in the larger towns, many of which were county seats, than in the very small ones. The Agricultural Extension Service took part in 43 percent of all the programs in 1958. It was most likely to be involved in towns between 1,000 and 10,000 in population. Agricultural projects included the recognition of outstanding farmers, 4-H Club days, dairy festivals, ivestock days, forestry days, agricultural tours, forestry queen contests, harvest festivals, and fairs. Some communities reported the construction of such agricultural facilities as hatcheries, feed mills, and grain elevators as projects in the Hometown Program.

A most significant link between the Hometown Program and the farm and other country people was the sponsorship by county development associations of open-country community clubs. This sponsorship in some counties was reported as a project in the Hometown Program. Since the early 1950's, between 25 and 30 Mississippi counties, or approximately one-third, have had area-wide development associations. Open-country community development sponsoring activities, as well as other rural and agricultural programs described above, appear to be more and more centered in terms of planning and leadership in the larger trade centers. especially the county seats.

Table 3. Comparison of sponsoring organizations in towns of various sizes in the Mississippi Hometown Development Program, 1958.

		Percent of towns reporting					
Sponsor	No. towns all sizes	All sizes (N=125)	500 and under (N=14)	501-1,000 (N=38)	1,001-2,500 (N=36)	2,501-10,000 (N=27)	Over 10,000 (N=10)
Chamber of Commerce	48	38	0	13	38	71	100
Civic club[1]	27	22	14	47	14	7	0
Development committee, club, or council	18	14	22	16	17	11	0
Town board	13	10	22	13	11	4	0
Joint sponsorship by clubs	7	6	21	8	3	0	0
All others[2]	12	10	21	3	17	7	0

[1] Fifty-nine percent of the civic club sponsors were Lions Clubs. In towns of 500 and under, 65 percent of the civic club sponsors were Lions Clubs; in towns 1,001 through 2,500, 40 percent; and in towns 2,501 through 10,000, 50 percent. The other civic clubs were Rotary, Jaycees, and clubs listed merely as civic clubs.

[2] All others consisted of two B.&P.W. Clubs, and one each of the following: Business Women's Clubs, Business Men's Association, Home Demonstration Club, Knights of Pythias, Travel Development Committee, City Planning Commission.

Table 4. Local organizations reported involved in different size towns in the Mississippi Hometown Development Program, 1958.

Types of organizations	Percent of towns reporting All sizes (N=125)	500 and under (N=14)	501-1,000 (N=38)	1,001-2,500 (N=36)	2,501-10,000 (N=27)	Over 10,000 (N=10)
Civic clubs (including men's service clubs & women's federated clubs)	80	57	82	92	85	50
City government (legislative)	71	64	66	78	85	40
Garden clubs	52	36	32	61	70	70
Chamber of Commerce	42	0	13	50	74	100
Agricultural Extension Service	43	29	26	47	70	40
Church	35	50	37	42	30	0
Parent-Teachers	32	21	29	42	33	20
School	30	29	13	39	52	10
Patriotic organizations	27	14	13	33	56	0
Board of supervisors	21	29	8	28	33	0
City administrative departments	20	7	5	22	44	20
Youth (extra-school)	18	14	13	22	30	0
Development association, community club and hometown development steering committee	18	21	18	19	19	0
Other agricultural organizations	17	21	5	28	22	0
Other business and industrial organizations	11	7	11	11	15	10
Fraternal organizations	11	14	8	3	30	0
Study clubs and music clubs	9	0	11	11	11	0
Outdoor sports clubs	6	0	0	6	22	0

Table 5. Differences in community organization procedures in the 1958 Mississippi Hometown Development Program between finalists and others.

Procedures hypothesized to affect success	All towns (N=125)	Finalists (N=22)	Others (N=103)
Involvement in analyzing needs and setting goals:			
Percent inviting all citizens or highly representative groups to participate	77	100	72
Percent where a few participated	10	0	13
Percent not reporting analysis of needs	13	0	15
Percent where Negroes did planning	10	23	7
Involvement in projects:			
Percent involving most organizations	66	91	61
Percent involving few organizations	19	9	21
Percent involving sponsor or sponsor and one other organization	15	0	18
Percent involving Negro groups	25	50	19
Projects planned and completed:			
Percent completing all or large number	61	100	52
Median number projects planned	10	12	10
Percent with longtime projects	82	100	79
Use of non-local professional resources:			
Percent using free help	61	68	59
Percent using paid help	30	59	24
Variety of interests:			
Percent with projects for youth	86	96	83
Percent with projects for gainful employment	53	91	45
Percent with decided indication of a trade area program	34	59	28
Percent with projects especially for Negroes	44	73	38
Publicity:			
Percent with publicity in press, radio, etc.	78	100	73
Percent planning community-wide activities	70	86	67
Median number activities planned	3	4	3
Program evaluation:			
Percent reporting follow-up meetings and/or progress reports	55	91	48

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A Descriptive Analysis of the

Grade A Dairy Industry In Mississippi

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
STATE COLLEGE MISSISSIPPI

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A Descriptive Analysis of the Grade A Dairy Industry In Mississippi

By
VERNER G. HURT, A. D. SEALE, JR., and PHILLIP R. H. HARDY

Introduction

The supply-consumption balance of Grade A milk differs between geographic areas in Mississippi. While these differences between areas are generally recognized, information relative to the amount of Grade A milk produced and consumed in the various areas of the state is not common knowledge. Such information is a prerequisite to establishment and operation of effective policies and programs for the Grade A dairy industry in Mississippi.

This report presents a summary of data collected as a part of an overall study of the effect of location of production and processing facilities and of distribution patterns on the efficiency of fluid milk marketing in the South. Described herein are (1) Grade A production patterns and marketing facilities in the counties and geographic areas of Mississippi, and (2) Utilitzation and sales of Grade A milk in geographic areas of Mississippi.

Data pertaining to the number and size of dairy herds from which Grade A milk was sold and the average production per cow were obtained in cooperation with the Federal-State Crop and Livestock Reporting Service from a survey of Grade A dairies in Mississippi. Data on supplies, utilization and sales of fluid milk were obtained through the cooperation of fluid milk processors and distributors, state and private institutions, and the State Superintendent of Schools.

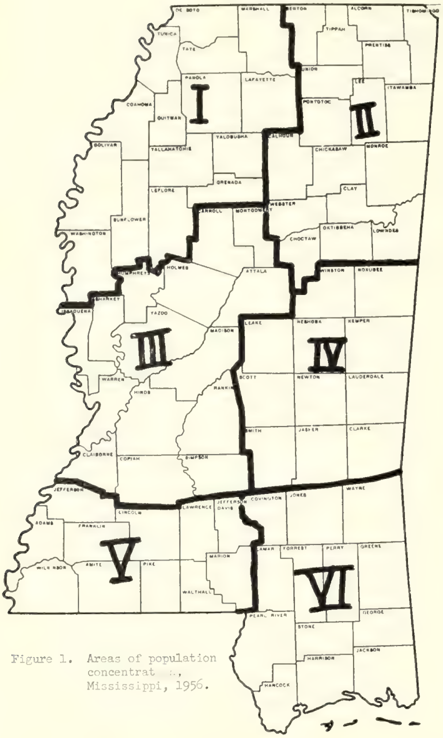
The Location of Production and of Milk Assembly Points

Geographic Areas: Mississippi has been divided into six geographic areas for the following analysis. The grouping of data by these six geographic areas prevents consideration of the supply-consumption balance by counties. However, such grouping was necessary to prevent disclosure of sales and utilization information for particular firms. Consequently, the inbalance between production and consumption indicated for a specific area may either understate or overstate the situation on a county basis.

The concentration of non-farm population was the primary factor considered in establishing the six geographic areas indicated by Roman numerals in Figure 1. However, a restriction that at least five bottling plants must be located within each area was imposed. Estimates of non-farm and total population for each geographic area are shown in Appendix Table 1.

Grade A Dairy Herds: On January 1, 1957, there were 4,198 dairy herds in Mississippi from which milk meeting Grade A requirements was sold, Table 1. The largest concentration of dairies was in southwest Mississippi, Area V. Counties with the largest numbers of herds were Walthall, with 327; Amite, with 306; and Pike, with 256; Appendix Table 2. One or more Grade A herds were reported for each county in the state except for Tunica, Quitman and Sharkey.

These herds contained nearly 145 thousand cows, or an average of 35 head per herd. Although southwest Mississippi had a much greater number of both herds and cows than did other areas, herds in that area were smaller than in most others. Herds were largest in Area I, northwest Mississippi, where they averaged 49 cows per dairy. In fact, Grade A dairy farmers in DeSoto County alone reported 11,981 cows, a number greater than that reported for any other Mississippi county, Appendix Table 2.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COAHOMA
PONTOTOC
QUITMAN
YALOBUSHA
CALHOUN
BOLIVAR
TALLAHATCHIE
CHICKASAW
MONROE
GRENADA
LEFLORE
CLAY
WEBSTER
CARROLL
MONTGOMERY
SUNFLOWER
OKTIBBEHA
LOWNDES
WASHINGTON
CHOCTAW
HOLMES
ATTALA
WINSTON
NOXUBEE
HUMPHREYS
SHARKEY
ISSAQUENA
YAZOO
MADISON
LEAKE
NESHOBA
KEMPER
WARREN
HINDS
RANKIN
SCOTT
NEWTON
LAUDERDALE
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
JEFFERSON DAVIS
COVINGTON
JONES
WAYNE
LINCOLN
LAWRENCE
ADAMS
FRANKLIN
LAMAR
FORREST
PERRY
GREENE
MARION
WILKINSON
AMITE
PIKE
WALTHALL
PEARL RIVER
STONE
GEORGE
HARRISON
JACKSON
HANCOCK

Figure 1. Areas of population concentration, Mississippi, 1956.

Average production per cow did not differ very much between areas. The average for the state was 4,507 pounds, Table 1.

Milk Assembly Points: The number of milk assembly points within areas ranged from 8 in Area IV to 20 in Area VI. The number of assembly points by types within each area are summarized in Table 2.

Production, Utilization and Sales of Grade A Milk

Farm Production and Sales: During the period July 1, 1956—June 30, 1957 approximately 653 million pounds of Grade A milk were produced in Mississippi. Summaries of farmer reports indicated that about 3 percent of the total production was used on the farm. This factor was applied to the estimated total production in each area to obtain an estimate of the total volume sold—633 million pounds. About 85 percent of this volume was sold to plants located in Mississippi and 15 percent was sold directly to plants outside of Mississippi.

Production and sales by farmers in

Table 1. Number of Grade A herds, estimated number of Grade A milk cows,* average number of cows per herd, and average annual production per cow, by geographic areas: Mississippi, January 1, 1957.

Geographic areas	Number of Grade A herds**	Estimated number of Grade A milk cows**	Average number of cows per herd	Average annual production per cow***
		Number		Pounds
Area I	483	23,751	49	4,546
Area II	851	28,341	33	4,457
Area III	369	13,312	36	4,474
Area IV	480	17,253	36	4,616
Area V	1,301	40,253	31	4,565
Area VI	708	21,715	31	4,353
Total	4,198	144,900	35	4,507

Source: Mississippi Crop and Livestock Reporting Service survey data.

* Includes heifers two years old and over.

** Data for counties with three Grade A dairies or fewer included in state total only.

*** July 1956 - June 1957 average.

Table 2. Number of assembly points by geographic areas: Mississippi, July 1956 - June 1957.

Assembly points	Geographic areas						Total
	I	II	III	IV	V	VI	
				Number			
Bottling plants	9	13	7	5	8	9	51
Producer-distributors	3	1	2	1	—	8	15
Receiving stations	—	5	1	2	4	1	13
Institutions	1	—	6	—	1	2	10
Total	13	19	16	8	13	20	89

Area V accounted for about 28 percent of the total for the state while Area III accounted for only 9 percent of the total. Estimated quantities produced and sold by farmers by areas are summarized in Table 3. Estimated production by areas, by counties, and by months are summarized in Appendix Tables 3-8.

Plant Receipts and Utilization: Fluid milk plants in Mississippi obtain most of their fluid milk supplies from producers in their area. Occasionally it is necessary for plants to obtain supplementary supplies from other plants. In this report "other sources" are classified as plants within Mississippi, plants outside of Mississippi and plants for which the location was not ascertained.

During the period July 1956—June 1957, fluid milk plants in Mississippi received about 605 million pounds of milk, Table 4. Approximately 43 million pounds of this total were sold as fluid milk to other plants located within the state. The latter quantity was counted twice since it was received by two different plants. More than 60 percent of the plant receipts in each area came directly from producers. A relatively small percentage of supplies in any area came from out-of-state plants.

Most of the milk received by plants is processed into fluid products, manufactured products such as ice cream, cottage cheese, etc. or sold as bulk milk to other plants. A considerable part of the milk sold as bulk milk was reported by receiving stations; however, most plants sell some milk, especially during the spring months, as bulk milk. About 86 percent of the total milk used by plants in Area I was processed into bottled products while only 13 percent was used for this purpose in Area V. Slightly less than one-half of the milk used by all plants in

Table 3. Estimated total Grade A milk production and farm sales, by geographic areas: Mississippi, July 1956 - June 1957.

Geographic areas	Milk production on Grade A dairy farms	Percent of state total	Milk sold by farmers
	000 pounds	Percent	000 pounds
Area I	107,964	16.53	104,725
Area II	126,324	19.34	122,534
Area III	59,553	9.12	57,766
Area IV	79,643	12.20	77,254
Area V	183,756	28.14	178,243
Area VI	94,525	14.47	91,689
Unclassified*	1,307	0.20	1,269
Total	653,072	100.00	633,480

Source: Mississippi Crop and Livestock Reporting Service survey data.
*Data from counties with three Grade A dairies or fewer are not included in area totals.

Table 4. Plant receipts of milk, by source of supply, by geographic areas: Mississippi, July 1956 - June 1957.

Source of supply	Geographic areas						State
	I	II	III	IV	V	VI	
	Thousand pounds						
Producers	39,939	121,714	78,492	67,757	137,897	94,582	540,381
Other sources:							
Plants within Mississippi	18,881	4,631	2,950	3,468	3,421	9,531	42,882
Plants outside Mississippi	5,483	1,039	71	35	1,056	859	8,543
Location not ascertained	1,146	1,521	5,916	832	431	3,056	12,902
Total receipts	65,449	128,905	87,429	72,092	142,805	108,028	604,708
	Percent						
Producers	61.0	94.4	89.8	94.0	96.6	87.6	89.4
Other sources:							
Plants within Mississippi	28.8	3.6	3.4	4.8	2.4	8.8	7.1
Plants outside Mississippi	8.4	.8	.1	*	.7	.8	1.4
Location not ascertained	1.8	1.2	6.7	1.2	.3	2.8	2.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Less than .05 percent.

the state was bottled. Approximately one-half was sold as bulk milk. Bulk milk accounted for about 83 percent of the total utilization in Area V and only 6 percent in Area I, Table 5.

Products and Containers: Homogenized milk accounted for 70-80 percent of the total volume of fluid products sold by plants located in each of the areas, Table 6. Non-homogenized milk, buttermilk and flavored milk accounted for most of the remainder. These four products accounted for about 97 percent of the total volume of fluid products for the state.

More than half of the fluid milk sold was packaged in quart containers, Table 7. This relationship held in all areas except Area I and III. In the latter areas, the popularity of half-gallon containers reduced somewhat the lead held by sales in quarts. Sales in half-pint containers were greater in Area VI, the Gulf Coast Area, than in any other area.

Table 5. Plant utilization of milk, by type of product, by geographic areas: Mississippi, July 1956 - June 1957.

Type of products	Geographic areas						State
	I	II	III	IV	V	VI	
	Thousand pounds						
Fluid products	55,415	42,721	57,138	35,389	19,213	69,437	279,313
Manufactured products	5,501	1,898	9,621	562	5,020	6,652	29,254
Bulk milk	3,663	83,546	19,663	35,227	120,301	30,322	292,722
Total utilization	64,579	128,165	86,422	71,178	144,534	106,411	601,289
	Percent						
Fluid products	85.8	33.3	66.1	49.7	13.4	65.2	46.4
Manufactured products	8.5	1.5	11.1	.8	3.4	6.3	4.9
Bulk milk	5.7	65.2	22.8	49.5	83.2	28.5	48.7
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6. Percentage distribution of fluid milk sales, by type of product, by geographic areas: Mississippi, July 1956 - June 1957.

Type of product	Geographic areas*						State
	I	II	III	IV	V	VI	
	Percent						
Homogenized milk	76.0	79.2	78.9	74.7	71.6	73.2	75.9
Non-homogenized milk	2.6	1.0	3.2	4.0	11.2	8.7	4.7
Skim milk	0.6	0.2	1.0	1.1	0.4	1.5	0.9
Buttermilk	11.2	11.4	9.5	12.0	8.0	4.6	9.1
Flavored milk	7.8	7.6	5.2	6.5	6.6	9.9	7.5
Flavored milk drink**	0.6	—	0.6	0.1	0.8	0.4	0.4
Half & Half (Light)	0.7	0.1	1.1	0.9	0.8	1.2	0.9
Medium cream	—	0.1	0.2	0.2	0.1	0.3	0.2
Heavy cream	0.3	0.3	0.3	0.3	0.4	0.1	0.3
Other***	0.2	0.1	—	0.2	0.1	0.1	0.1
	Thousand pounds						
Total	55,415	42,721	57,138	35,389	19,213	69,437	279,313

*Denotes location of plant.

**Flavored milk drink containing less than 3.5 percent butterfat.

***Includes sour cream and egg-nog.

Table 7. Percentage distribution of fluid milk sales, by size of container, by geographic areas: Mississippi, July 1956 - June 1957.

Size of containers	Geographic areas*						State
	I	II	III	IV	V	VI	
	Percent						
Gallons**	1.2	2.2	2.4	3.6	2.8	3.8	2.6
Half-gallons	35.6	20.0	32.8	25.0	12.2	9.4	22.2
Quarts	45.0	59.4	46.6	57.2	67.4	61.8	56.0
Pints	1.2	0.2	1.6	1.8	0.6	1.2	1.0
Third-quarts	—	0.4	0.4	0.2	—	—	0.2
Half-pints	17.0	17.8	16.2	12.2	17.0	23.8	18.0
	Thousand pounds						
Total	55,415	42,721	57,138	35,389	19,213	69,437	279,313

*Denotes location of plants.

**Dispenser milk.

Ice cream and ice cream mixes accounted for more than 90 percent of the manufactured products in each area when butter and condensed milk were omitted. Data for the latter two products could not be shown because of the limited number of plants engaged in production. Cottage cheese accounted for less than 8 percent of the manufactured products in each of the areas. Container sizes for manufactured products were not obtained in the survey.

Sales of Fluid Milk: About 300 million pounds in fluid milk equivalents were sold as fluid milk and manufactured products by plants in Mississippi to consumers and retail establishments in Mississippi. Approximately 27 percent of this volume was sold in Geographic Area VI and 23 percent in Geographic Area III. Sales in Area V accounted for less than 10 percent of the market.

Annual per capita sales, based on total population of the state, were 142 pounds, Table 8. Fluid products made up about 92 percent of the volume and manufactured products 8 percent. Sales per person varied widely between areas, ranging from 101 pounds in Area I to 226 pounds in Area VI. These data are not to be construed as estimates of per capita consumption of dairy products: two important components are missing. First, the data do not include quantities sold by out-of-state plants directly to consumers or retailers in Mississippi. Secondly, the milk products consumed by many farm families are not purchased through commercial channels, but are home-produced.

Sales per non-farm person averaged 276 pounds for the state, and ranged from 241 pounds in Area III to 322 pounds in Area II. With total sales quantity given, area sales per non-farm person would be expected to vary inversely to the proportions of non-farm residents in the areas. That they did not do so indicates differences in the proportions of rural residents that purchased milk products through commercial channels.

Effects of Urbanization on Fluid Product Sales: According to the Department of Sociology and Rural Life, Mississippi State University, the total population for Mississippi in 1975 will be about the same as in 1956. Consequently, the dairy industry of Mississippi can expect little if any increase in sales of fluid milk products in Mississippi unless there is an increase in sales per capita. Indications are that the population shift from farm to non-farm in Mississippi is increasing per capita sales.

Regression techniques were used to estimate the effect of urbanization on fluid product sales. The dependent variable was sales per person in each geographic area (Table 8), and the independent variable was the percent of total population in each geographic

Table 8. Volume of fluid and manufactured products sold by all Mississippi plants in each of the geographic areas of Mississippi, July 1956 - June 1957.

Description of sales	Unit	Geographic areas*						Total
		1	II	III	IV	V	VI	
Total sales into each area:								
Fluid products	000 lbs.	46,486.9	42,399.9	60,555.2	28,537.6	24,510.8	73,495.3	275,985.7
Mfg. products	000 lbs.	4,974.2	2,206.4	7,785.0	1,617.9	1,293.5	6,349.3	24,266.3
Total	000 lbs.	51,461.1	44,605.3	68,340.2	30,155.5	25,804.3	79,344.6	300,212.0
Sales per person:								
Fluid products	lb.	91.3	129.9	125.6	123.4	117.6	208.1	130.8
Mfg. products	lb.	9.8	6.8	16.1	7.0	6.2	18.0	11.5
Total	lb.	101.1	136.7	141.7	130.4	123.8	226.1	142.3
Sales per non-farm person:								
Fluid products	lb.	245.2	306.2	213.3	278.8	232.2	272.9	253.4
Mfg. products	lb.	26.2	15.9	27.4	15.8	12.3	23.6	22.2
Total	lb.	271.4	322.1	240.7	294.6	244.5	296.5	275.6

*Denotes the location of consumers or retail establishments to which products were sold.

area that was non-farm (Appendix Table 1). Results of this analysis indicated that a shift of 1 percent of the total population from farm to non-farm would result in an increase in sales of fluid products per person of 2.5 pounds per year. The percent of the total population that was non-farm explained 81 percent of the variation in sales per person. If the trend from farm to non-farm continues, by 1975 there would be an additional shift from farm to non-farm of 8 percent. This shift in population would increase total fluid product sales in the state by 40 million pounds by 1975. This would be an increase in total fluid product sales of about 14 percent from 1956-1957 to 1975.

Supply-Consumption Balance of Grade A Milk: Producers of Grade A milk in Mississippi sold approximately twice as much milk to plants and dealers as was resold as processed fluid milk and manufactured products to consumers in the state by these plants and dealers during the period July 1, 1956—June 30, 1957, Table 9. In all areas except Area III, producers sales of raw milk exceeded sales of processed products. The ratios of producer sales to plant sales varied widely between areas. A greater imbalance between areas except for Area III would be evidenced if sales of fluid products only were compared with sales of producer milk.

The differences in the supply-consumption balances of Grade A milk between areas of the state may result in conflicting interests with respect to policies and programs for the dairy industry in Mississippi.

Programs designed to facilitate shipments of milk into an area may be most desirable for areas with a low ratio of production to sales of fluid and manufactured products. For areas where there is an approximate balance, policies and programs excluding in-shipments of Grade A milk may be favored. However, when the balance for the entire state is considered, policies and programs designed to impede or restrict movements of Grade A milk within the state or between states may be harmful. If retaliatory policies and programs were developed by neighboring states, the following of restrictive policies could result in irreparable damage to and chaotic conditions in the Grade A Dairy Industry of Mississippi.

Summary and Conclusions

The purpose of this report was to describe (1) the location of production and marketing facilities, and (2) the supplies, utilization and sales for Grade A milk by geographic areas in Mississippi. Data were collected from producers, processors and distributors of Grade A milk and from governmental agencies in the state.

The state was delineated into six geographic areas based primarily on the concentration of non-farm population. On January 1, 1957, there were 4,198 dairy herds producing milk meeting Grade A requirements in Mississippi. The largest concentration of

Table 9. Supply-consumption balance for Grade A milk by geographic areas: Mississippi, July 1, 1956 - June 30 1957.

Area	Milk sold by farmers	Sales of fluid and manufacturing products	Difference	Milk sold/sales of fluid and manufacturing products
	000 pounds	000 pounds	000 pounds	Percent
I	104,725	51,461	53,264	204
II	122,534	44,605	77,929	275
III	57,766	63,340	(10,574)	84
IV	77,254	30,156	47,098	256
V	178,243	25,804	152,439	691
VI	91,689	79,845	11,844	115
Unclassified*	1,269	—	—	—
Total	633,480	300,211	333,269	211.0

*Sales by farmers in counties with three Grade A dairies or fewer not included in area totals.

herds and the largest number of cows was in southwest Mississippi, Area V. However, the average number of cows per herd in Area V was the same as or smaller than the average size of herds in other areas.

Average production per cow in herds meeting Grade A requirements during the 12 month period beginning July 1, 1956 ranged from 4,353 pounds in Area VI to 4,616 pounds in Area IV. Average production for the state was 4,507 pounds.

The primary source of fluid milk supplies for fluid milk plants in Mississippi was from regular producers. Receipts from plants located outside of Mississippi accounted for a relatively small percentage of the total receipts by plants in each area. Fluid products accounted for 46 percent of total plant utilization; manufactured products, 5 percent; and bulk milk, 49 percent during the period. About 96 percent of the volume of fluid milk products sold was packaged in half-gallon, quart, and half-pint containers.

A relatively stable total population is expected in Mississippi for the next 10-15 years. However, the percentage of the total population classified as non-farm will probably increase. Based on the expected increase in the non-farm segment of the population, increases in the total amount of fluid and manufactured products purchased through commercial channels would be expected.

The supply-consumption balance for Grade A milk differed between areas. Sales of Grade A raw milk to processors by producers by areas ranged from 84 to 691 percent of the sales of fluid and manufactured products by processors and distributors.

Overall, approximately twice as much Grade A milk was produced in Mississippi as was consumed within the state. Consequently, policies and programs developed by interests in Mississippi which restrict or impede movements of Grade A milk within the state or between states could harm the Mississippi industry, particularly if retaliatory measures were adopted in other areas.

APPENDIX TABLES

Appendix Table 1. Estimated non-farm and total population, by geographic areas: Mississippi, July 1, 1956.

Geographic areas	Non-farm population		Percent non-farm is of total	Total population	
	Area total	Percent of total		Area total	Percent of total
	Number	Percent	Percent	Number	Percent
Area I	189,621	17.4	37.2	509,100	24.1
Area II	138,488	12.7	42.4	326,400	15.5
Area III	283,844	26.1	58.9	482,100	22.8
Area IV	102,367	9.4	44.3	231,200	11.0
Area V	105,549	9.7	50.6	208,500	9.9
Area VI	269,295	24.7	76.3	353,100	16.7
State	1,089,164	100.0	51.6	2,110,400	100.0

Source: Adapted from Saunders, J. V. D., et al., Sociology and Rural Life Series No. 6, State College, Mississippi, November, 1957.

Appendix Table 2. Number of Grade A herds and estimated number of cows in Grade A herds, by counties, Mississippi, January 1, 1957.

County	Number of Grade A herds	Estimated number of cows*
Area I		
Bolivar	26	939
Coahoma	4	228
DeSoto	220	11,981
Grenada	**	**
Lafayette	8	415
Leflore	6	147
Marshall	42	2,262
Panola	14	758
Quitman	**	**
Sunflower	35	1,011
Tallahatchie	8	244
Tate	89	4,439
Tunica	**	**
Washington	17	707
Yalobusha	14	620
Area II		
Alcorn	58	1,427
Benton	6	152
Calhoun	42	1,075
Chickasaw	63	1,813
Choctaw	**	**
Clay	53	1,857
Itawamba	23	582
Lee	111	3,142
Lowndes	71	3,499
Monroe	50	1,747
Oktibbeha	117	5,995
Pontotoc	89	2,606
Prentiss	38	956
Tippah	14	358
Tishomingo	15	311
Union	71	1,705
Webster	30	1,116
Area III		
Attala	29	845
Carroll	7	231
Claiborne	**	**
Copiah	90	2,793
Hinds	21	736
Holmes	5	235
Humphreys	8	133
Issaquena	10	298
Madison	44	1,563
Montgomery	14	350
Rankin	61	3,060
Sharkey	**	**
Simpson	57	2,209
Warren	12	672
Yazoo	11	187
Area IV		
Clarke	12	362
Jasper	31	823
Kemper	12	452
Lauderdale	10	411
Leake	14	479
Neshoba	69	2,613
Newton	199	6,233
Noxubee	73	3,591
Scott	9	506
Smith	22	535
Winston	29	1,248
Area V		
Adams	6	387
Amite	306	9,634
Franklin	17	451
Jefferson	**	**
Jefferson Davis	24	574
Lawrence	34	937
Lincoln	179	6,115
Marion	152	4,273
Pike	256	7,321
Walthall	327	10,561
Wilkinson	**	**
Area VI		
Covington	25	680
Forrest	63	2,551
George	34	915
Greene	9	315
Hancock	89	2,702
Harrison	46	1,122
Jackson	24	838
Jones	96	3,888
Lamar	33	934
Pearl River	199	5,360
Perry	6	175
Stone	67	1,831
Wayne	17	404

Source: Mississippi Crop and Livestock Reporting Service.

*Includes heifers two years old and older.

**Three Grade A dairies or fewer.

Appendix Table 3. Estimated production of Grade A milk, by counties, by months: Geographic Area I, Mississippi, July 1956 - June 1957.

Geographic area	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
	Months												
Area I						Thousand pounds							
Bolivar	355	350	345	346	345	362	407	386	469	506	516	448	4,835
Coahoma	97	95	94	94	94	99	112	107	128	135	131	114	1,300
DeSoto	4,218	4,131	4,049	4,088	4,107	4,336	4,447	4,226	4,711	5,023	5,213	4,813	53,362
Grenada*	—	—	—	—	—	—	—	—	—	—	—	—	—
Lafayette	146	143	140	141	142	150	156	143	160	171	175	146	1,813
Leflore	54	53	52	49	47	49	55	53	59	70	72	64	677
Marshall	851	834	817	825	829	875	904	858	957	991	1,019	941	10,701
Panola	253	248	243	245	246	260	271	260	272	291	302	278	3,169
Quitman**	—	—	—	—	—	—	—	—	—	—	—	—	—
Sunflower	404	399	394	374	352	369	420	408	455	508	516	462	5,061
Tallahatchie	70	69	69	69	69	72	80	79	97	105	110	100	989
Tate	1,564	1,532	1,502	1,516	1,523	1,608	1,648	1,570	1,739	1,864	1,933	1,784	19,783
Tunica**	—	—	—	—	—	—	—	—	—	—	—	—	—
Washington	301	297	293	278	262	275	316	306	342	363	371	329	3,733
Yalobusha	200	196	192	194	195	206	207	199	221	240	254	237	2,541
Total	8,513	8,347	8,190	8,219	8,211	8,661	9,023	8,595	9,610	10,267	10,612	9,716	107,964

Appendix Table 4. Estimated production of Grade A milk, by counties, by months: Geographic Area II, Mississippi, July 1956 - June 1957.

Geographic area	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	Total
	Months												
Area II						Thousand pounds							
Alcorn	448	442	436	443	442	463	472	472	527	555	557	505	5,762
Benton	54	53	52	53	53	56	57	55	60	65	67	62	687
Calhoun	354	347	340	343	345	364	374	353	396	425	433	398	4,472
Chickasaw	626	622	617	619	610	635	652	602	683	744	791	696	7,893
Choctaw*	—	—	—	—	—	—	—	—	—	—	—	—	—
Clay	671	666	661	663	653	681	698	663	731	801	842	730	8,460
Itawamba	212	209	296	210	209	219	225	224	249	258	260	238	2,719
Lee	1,157	1,142	1,127	1,145	1,142	1,198	1,243	1,226	1,354	1,398	1,400	1,253	14,785
Lowndes	1,272	1,262	1,254	1,257	1,238	1,290	1,325	1,227	1,389	1,518	1,620	1,405	16,057
Monroe	571	567	563	565	556	579	588	549	622	692	743	666	7,261
Oktibbeha	2,058	2,043	2,029	2,034	2,003	2,087	2,138	1,987	2,214	2,430	2,587	2,334	25,944
Pontotoc	886	874	862	876	874	917	940	945	1,054	1,093	1,100	1,002	11,423
Prentiss	342	337	333	338	337	354	365	359	400	416	420	384	4,385
Tippah	127	125	123	125	125	131	138	132	147	152	153	140	1,618
Tishomingo	115	114	112	114	114	119	122	122	136	142	144	130	1,484
Union	677	667	659	669	668	700	741	711	786	786	786	700	8,550
Webster	379	380	369	370	376	394	403	377	420	455	464	437	4,824
Total	9,949	9,850	9,743	9,824	9,745	10,187	10,481	10,004	11,168	11,930	12,367	11,076	126,324

Source: Based on Grade A dairy survey data collected by the Mississippi Crop and Livestock Reporting Service, Mississippi Department of Agriculture and Commerce, Statistics Division, Jackson, Mississippi, in cooperation with Agricultural Economics Department, Mississippi Agricultural Experiment Station, State College, Mississippi, January 1, 1957 - June 30, 1957.

*Counties having three Grade A dairies or fewer are included in the state totals only.

**None reported.

Appendix Table 5. Estimated production of Grade A milk, by counties, by months: Geographic Area III, Mississippi, July 1956 - June 1957.

Geographic area	Months												Total
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	
	Thousand pounds												
Area III													
Attala	318	319	310	311	315	331	338	315	359	396	404	382	4,098
Carroll	64	65	63	63	64	67	69	65	74	82	73	71	820
Claiborne*	—	—	—	—	—	—	—	—	—	—	—	—	—
Copiah	987	974	954	957	954	1,001	1,023	958	1,090	1,152	1,163	1,075	12,288
Hinds	264	261	255	256	256	268	274	258	291	305	305	281	3,274
Holmes	79	80	77	78	79	83	84	79	88	96	99	88	1,010
Humphreys	41	40	40	38	35	37	42	42	47	61	62	58	543
Issaquena	132	130	128	122	115	121	140	131	145	157	161	139	1,621
Madison	587	589	572	573	582	610	625	582	649	702	714	650	7,435
Montgomery	98	98	95	95	97	101	104	97	104	115	120	114	1,238
Rankin	1,139	1,143	1,108	1,111	1,127	1,183	1,215	1,128	1,256	1,336	1,344	1,259	14,349
Sharkey**	—	—	—	—	—	—	—	—	—	—	—	—	—
Simpson	777	762	753	754	756	798	822	775	860	882	893	833	9,665
Warren	194	192	188	188	188	197	198	189	213	231	239	235	2,452
Yazoo	59	59	58	55	52	54	59	59	66	79	82	78	760
Total	4,739	4,712	4,601	4,601	4,620	4,851	4,993	4,678	5,242	5,594	5,659	5,263	59,553

Appendix Table 6. Estimated production of Grade A milk, by counties, by months: Geographic Area IV, Mississippi, July 1956 - June 1957.

Geographic area	Months												Total
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	
	Thousand pounds												
Area IV													
Clarke	148	146	145	145	145	151	156	149	166	173	168	151	1,843
Jasper	314	309	308	308	307	320	330	310	350	367	345	304	3,872
Kemper	182	181	180	180	178	185	192	173	178	192	200	177	2,198
Lauderdale	162	160	159	159	158	165	170	163	183	203	190	170	2,042
Leake	137	137	133	133	136	142	146	137	154	172	178	168	1,773
Neshoba	960	952	946	949	934	973	996	925	1,039	1,139	1,203	1,043	12,059
Newton	2,560	2,525	2,517	2,510	2,506	2,614	2,697	2,562	2,865	2,951	2,762	2,481	31,550
Noxubee	1,185	1,177	1,169	1,172	1,154	1,203	1,228	1,150	1,289	1,432	1,524	1,378	15,061
Scott	154	155	150	151	153	160	162	152	170	186	193	185	1,971
Smith	169	165	163	164	165	173	179	170	190	196	200	190	2,124
Winston	404	401	399	400	394	410	420	389	437	486	530	480	5,150
Total	6,375	6,308	6,269	6,271	6,230	6,496	6,676	6,280	7,021	7,497	7,493	6,727	79,643

Source: Based on Grade A dairy survey data collected by the Mississippi Crop and Livestock Reporting Service, Mississippi Department of Agriculture and Commerce, Statistics Division, Jackson, Mississippi, in cooperation with Agricultural Economics Department, Mississippi Agricultural Experiment Station, State College, Mississippi, January 1, 1957 - June 30, 1957.

*Counties having three Grade A dairies or fewer are included in the state totals only.

**None reported.

Appendix Table 7. Estimated production of Grade A milk, by counties, by months: Geographic Area V, Mississippi, July 1956 - June 1957.

Geographic area	Months												Total
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	
	Thousand pounds												
Area V													
Adams	117	115	113	113	112	118	121	115	128	135	161	148	1,496
Amite	3,675	3,624	3,553	3,562	3,554	3,727	3,829	3,560	3,946	4,073	4,032	3,645	44,780
Franklin	136	134	131	132	131	138	142	134	145	151	150	146	1,670
Jefferson*	—	—	—	—	—	—	—	—	—	—	—	—	—
Jefferson Davis	187	184	181	182	182	192	196	188	209	212	214	202	2,329
Lawrence	291	286	282	283	284	299	306	288	330	351	360	346	3,706
Lincoln	2,339	2,307	2,262	2,268	2,263	2,373	2,431	2,312	2,612	2,738	2,690	2,463	29,058
Marion	1,605	1,575	1,554	1,559	1,563	1,647	1,700	1,584	1,744	1,787	1,763	1,578	19,659
Pike	2,464	2,418	2,386	2,393	2,399	2,529	2,603	2,453	2,723	2,786	2,791	2,688	30,633
Walthall	4,110	4,033	3,980	3,992	4,002	4,218	4,356	4,085	4,493	4,577	4,490	4,089	50,425
Wilkinson*	—	—	—	—	—	—	—	—	—	—	—	—	—
Total	14,924	14,676	14,442	14,484	14,490	15,241	15,684	14,719	16,330	16,810	16,651	15,305	183,756

*Counties having three Grade A dairies or fewer are included in the state totals only.

Appendix Table 8. Estimated production of Grade A milk, by counties, by months: Geographic Area VI, Mississippi, July 1956 - June 1957.

Geographic area	Months												Total
	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	
	Thousand pounds												
Area VI													
Covington	276	271	267	268	269	283	290	274	304	310	313	297	3,422
Forrest	1,049	1,035	1,032	1,029	1,027	1,072	1,104	1,059	1,187	1,235	1,165	1,045	13,039
George	288	284	284	283	282	294	301	294	330	348	341	310	3,639
Greene	101	100	100	99	99	103	106	104	116	123	122	111	1,284
Hancock	840	828	826	824	822	858	880	862	955	1,021	1,017	925	10,658
Harrison	339	334	333	332	332	346	356	348	398	407	406	371	4,302
Jackson	258	255	254	253	253	264	271	260	284	301	294	272	3,219
Jones	1,482	1,462	1,458	1,454	1,451	1,514	1,559	1,490	1,676	1,751	1,651	1,476	18,424
Lamar	345	338	334	335	335	354	377	329	365	371	369	346	4,198
Pearl River	1,751	1,727	1,721	1,716	1,714	1,788	1,840	1,785	2,005	2,102	2,122	1,960	22,231
Perry	83	82	82	81	81	85	87	82	91	88	83	74	999
Stone	557	549	547	546	545	568	591	543	596	623	630	582	6,877
Wayne	187	185	184	183	183	191	197	187	167	204	192	173	2,233
Total	7,556	7,450	7,422	7,403	7,393	7,720	7,959	7,617	8,474	8,884	8,705	7,942	94,525
Other counties*	106	104	101	102	103	107	109	103	119	123	121	109	1,307
State Total	52,162	51,447	50,768	50,904	50,792	53,263	54,925	51,996	57,964	61,105	61,608	56,138	653,072
Percent of total	7.98	7.88	7.77	7.79	7.78	8.16	8.41	7.96	8.88	9.36	9.43	8.60	100.0

Source: Based on Grade A dairy survey data collected by the Mississippi Crop and Livestock Reporting Service, Mississippi Department of Agriculture and Commerce, Statistics Division, Jackson, Mississippi, in cooperation with Agricultural Economics Department, Mississippi Agricultural Experiment Station, State College, Mississippi, January 1, 1957 - June 30, 1957.

*Estimated production for all counties with three Grade A dairies or fewer.

Appendix Table 9. Estimated volume of Grade A milk sold*, by producers, by geographic areas, by months: Mississippi, July 1956 - June 1957.

Month	Geographic areas						Total
	I	II	III	IV	V	VI	
				Pounds			
July	8,258	9,651	4,597	6,184	14,476	7,329	50,597
August	8,097	9,555	4,571	6,119	14,236	7,227	49,904
September	7,944	9,451	4,463	6,081	14,009	7,199	49,245
October	7,972	9,529	4,463	6,083	14,049	7,181	49,377
November	7,965	9,453	4,481	6,043	14,055	7,171	49,268
December	8,401	9,881	4,705	6,301	14,784	7,488	51,665
January	8,752	10,167	4,843	6,476	15,213	7,720	53,277
February	8,337	9,704	4,538	6,092	14,277	7,388	50,436
March	9,322	10,833	5,085	6,810	15,840	8,220	56,225
April	9,959	11,572	5,426	7,272	16,306	8,617	59,272
May	10,294	11,996	5,489	7,268	16,151	8,444	59,760
June	9,425	10,744	5,105	6,525	14,846	7,704	54,454
Total	104,725	122,534	57,766	77,254	178,243	91,689	633,480**

*It is estimated from Grade A dairy survey reports that approximately 97 percent of the total Grade A milk production was sold to fluid milk handlers.

**Includes 1,267 thousand pounds sold by counties that reported less than four dairies and not included in the area totals.

BULLETIN 620 MAY, 1961

Food Purchases and Use Practices of families of Gainfully Employed Homemakers

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By

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SUMMARY

The objective of this study was to provide basic information for adjusting production and marketing to needs of families whose homemakers are gainfully employed away from home.

The eligibility requirements for families in the study were: (1) Homemaker employed 30 hours or more away from home past week; (2) Family had both husband and wife, with or without children; (3) Served at least one meal each day at home past week; (4) White or Negro family. Four groups of families were included: urban whites, rural whites, urban Negroes and rural Negroes. Each group consisted of 135 families (45 in each of three seasons—fall, winter, late spring-early summer).

The average income of families during the year preceding the interview was for urban white families, $5972; for rural white families, $5381; for urban Negro families, $3063; and for rural Negro families, $2071. (Only 27 percent of the rural white families and 23 percent of the rural Negro families operated a farm.)

The average size of the household during the report week was for urban white families 3.16 members; for rural white families 3.68 members; for urban Negro families 3.53 members; and for the rural Negro families 4.85 members.

The type of work in which most homemakers were engaged was the same for three groups—rural whites, urban Negroes and rural Negroes. This type of work was semi- and unskilled wage work. More white urban homemakers were white collar workers (clerks, secretaries and the like).

In the majority of families in each of the four groups the wife did not prepare all meals. Gainful homemakers spent an average of from 1 - 2 hours in food preparation and dishwashing on a weekday. In white families members whose meals were not prepared by the wife most often ate at a lunchroom or cafe or the meals were prepared by a maid. In Negro families these meals were most often prepared by older children or husband. In all groups of families except the rural Negro assistance was obtained from husbands by relatively more homemakers than was obtained from school children. More Negro rural families had school children and they averaged more school children per family than did families in the other groups.

The traditional meal pattern is dinner at noon and leftovers at supper. However, in this group of gainful homemaker families the main meal had shifted to the evening meal, with no one characteristic noon meal. The sandwich—salad type of noon meal was the one used by more families in this study, but was less important in the rural Negro group. Also, a shift away from home baking was noted especially in baking of biscuits by the white urban group.

From a comparison with other studies there seems to have been also a shift away from home production by the rural family. The gainful-wife rural family of this study had better food facilities than farm-operator families in other studies recently made. Average cost plus money value of food used per capita during the report week ranged from $7.66 for urban white to $3.51 for rural Negro families. It was $6.45 for rural white families and $4.78 for urban Negro families. Eleven percent of the cost plus money value of food used by white rural families was for home produced foods and gifts of foods. The percentages for white urban, Negro rural and Negro urban were 4 percent, 18 percent, and 7 percent, respectively.

In 73 percent of the urban white families, in 80 percent of the rural white families, in 49 percent of the urban Negro and 50 percent of the rural Negro families one or more meals had been purchased during the report week by a family member or members at a lunchroom, cafe, or restaurant. Average expenditures for these meals were for urban white families having such expenses, $4.03; for rural white families, $4.74; for urban Negro families,

$2.18; and for rural Negro families, $2.39.

Diets of families in this study followed the general pattern of diets found in studies of families in other areas—that is, they showed greater shortages in ascorbic acid, vitamin A value and calcium than in other nutrients. Shortages were greater for rural than for urban families; greater for Negro than for white families.

For most types of food, consumption per capita was greater for the urban than the rural family as, for example, meats, fish and poultry; fruits and vegetables (except dried).

New forms of foods were used to a greater extent by urban white families, next by rural white families and least by Negro rural families. These included such foods as fruit juices, instant coffee, frozen meat pies and canned biscuit.

No great variation in amounts and kinds of purchased foods used during three seasons was found. It was noted that there was a tendency on the part of rural families not to use certain fruits and vegetables throughout the year as did the urban families.

Gainful employment of homemakers will change the demand for food in the State because (1) The most rapidly growing group of gainful wife families is the white urban group. This group (a) uses more meat, fish, poultry, fruit, vegetables than other groups of gainful white families, (b) is less wedded to traditional menus and foods. (2) Families of rural gainfully employed women are shifting from home production of foods to purchase. (3) There is more eating at restaurants, lunchrooms, cafes. (4) Men and boys in gainful wife families are playing an increasing role in family food activities.

ERRATA

Table III Schooling of gainfully employed homemakers.

Schooling	White urban	White rural	Negro urban	Negro rural
	Percent	Percent	Percent	Percent
8th grade or less	6	11	50	77
9 - 11 grades	18	32	22	10
High school graduate	43	39	10	7
College training	33	18	18	6
No. families	135	135	135	135

In Tables VI and VIII the words "urban" and "rural" should be transposed.

Food Purchases and Use Practices of Families of Gainfully Employed Homemakers

By DOROTHY DICKINS

INTRODUCTION

The growing tendency of homemakers to work away from home increases the dependence of families on the market. How is choice and use of food affected? A reply to this question is important not only to producers and distributors but to the family itself. Basic information is needed for adjusting production and marketing to demands and needs of this rapidly increasing group.

In late spring and early summer of 1956 data concerning food purchases and use practices were obtained from 100 rural white families with wives employed in three garment plants of Mississippi and with 100 similar families residing in the same rural neighborhoods with wives not gainfully employed.[1] Two differences were found: (1) In the source of certain foods used, and (2) In the use of ready-prepared foods.

The gainful homemaker families of this 1956 study resided in rural areas. The majority operated farms. To more fully understand and interpret changes in demand for various foods and marketing services resulting from increasing numbers of homemakers entering gainful work it was decided to expand the study to include families with wife engaged in all kinds of gainful work, urban as well as rural families, Negro as well as white families and the fall and winter seasons as well as the late spring-early summer season. It is the purpose of this study to provide information on which effective education, promotional, and marketing programs can be based and thus furnish gainful wife families aid in obtaining kinds of foods they need and want.

SCOPE AND METHODS

Families with wife gainfully employed were drawn from urban and rural areas in seven counties of the State—Forrest, Lowndes, Marshall, Newton, Pike, Sunflower and Washington. The block method of sampling was used in the rural areas and in five of the seven urban areas.[2] In two of the urban areas, Holly Springs and Newton, city maps were not available. In these two cities samples were taken by random selection of household users of electricity.

The three urban samples (one for each season) were drawn in Hattiesburg, Columbus, Holly Springs, Newton, McComb, Indianola and Greenville and the three rural samples were drawn in a 10-mile radius around these cities including a random sample of households living in villages (towns of less than 2500 population) within the 10-mile radius. The sample areas were different for each season. This means that no one family was asked to cooperate except for one season.

Schedules from 45 eligible families were obtained for each of the four types of families (white urban, white rural, Negro urban and Negro rural) in each of the three seasons (fall, winter, and late spring-early summer). The number of families from each county was based on the relative proportion of families in these counties as shown by 1950 census population data. To be eligible for this study the family must (1) have a homemaker employed away from home 30 hours or more during the 7 days preceding the interview, (2) there must be both husband and wife and the husband must reside at home, (3) the family must have served at least one meal each day at home during the past 7 days, (4) the family must be a white or Negro family.

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[1] Food Use and Gainful Employment of the Wife. Dorothy Dickins. Miss. Agr. Exp. Station Bull. 558, May, 1958.

[2] Sample Survey Methods and Theory, Vol. 1, by M. H. Hansen, W. N. Hurwitz and W. G. Madow. John Wiley and Sons, Inc., 1953. This method was suggested by Dr. Earl E. Houseman, Director, Statistical Standards Division, Agricultural Marketing Service, U.S.D.A.

Twenty-five percent of the families in the sample areas drawn were eligible for the study. The percentage eligible in the four groups was about the same, that is, 26 percent for rural whites and 24 percent for the other three groups. The greatest seasonal variations in eligibility were found in the rural Negro group. Only 18 percent were eligible in winter and 29 percent in late spring-early summer when farm wage work was available. Homemakers who worked at home on their own crop were not eligible for this study.

Most families (49 percent) were ineligible for this study due to homemaker not working away from home at least 30 hours during the week preceding the interview. Included in this group were a few double families in which a daughter-in-law or daughter might be gainfully employed but was not the homemaker in the family. The mother-in-law or mother was the homemaker.

However, there were families included in which there were older relatives residing with the gainful wife families, yet the wife served as the homemaker as far as food was concerned. These older people, however, often assisted the wife in carrying out her plans. Older females able to do some housework were found in 10 percent of the homes of rural white women, in 7 percent of the homes of urban white women, in 18 percent of the homes of rural Negro women and in 16 percent of the homes of urban Negro women.[3]

About one-fifth of the families were ineligible because the family did not include both husband and wife. Only 14 eligible families refused to cooperate. Included in this group were several who had illness during the study period.[4]

Data were obtained in the falls of 1958 and 1959, in the winters of 1959 and 1960 and in the late spring-early summers of 1959 and 1960 by personal interview with the use of schedule. A total of 540 schedules were completed—180 during each season. These were from families of four types: 45 urban white, 45 rural white, 45 urban Negro and 45 rural Negro.

Description of Families

Homemakers were asked to give information concerning family income during the past year. Family income included gross amount in wages, salaries, bonuses and commissions of all economic family members; receipts from farm or business operated minus farm or business expenses; and all other income, such as pensions, veteran payments, unemployment insurance, net from rental property, interest from bonds.

The average income for each of the four groups of 135 families (45 in each of three seasons) was as follows:

Group	Average income
	Dollars
Urban white	5972
Rural white	5381
Urban Negro	3063
Rural Negro	2071

It is important in interpretation of data during different seasons to know if the samples of families cooperating in these seasons differ. Differences in families rather than in season may explain differences in food.

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[3] Diets of families with older females in the family were compared with diets of families without older females. There was no difference in adequacy in the case of white families, but Negro families both rural and urban with older females much more often had diets with one or more nutrients of less than 2/3 NRC recommendations than did those without older females.

[4] The other families were ineligible because they were non-white (other than Negro) or did not serve at least one meal at home each day.

Incomes of white families and of urban Negro families cooperating in each of three seasons were about the same. Rural Negro families, however, in the winter sample had somewhat higher incomes than those in the other two samples.[5] During the winter women who did farm wage work off the farm were not working to any great extent and therefore did not as often meet eligibility requirements of this study. But even though the winter sample contained more families with a total higher annual income than did the fall and late spring-early summer samples, diets were no better. The winter season is a "bad time" for all low-income rural families since there is a limited amount of off-farm work available, not only for the wife but also for other members. The wife might have work then, but her husband might be working only part-time, or not at all.

The average size of the household during the report week was for the urban white family 3.16 members, for the rural white family 3.68 members; for urban Negro families 3.53 members; and for the rural Negro family 4.85 members. Household size was computed by dividing the total number of meals served during the week by 21 meals per week. An analysis of variance on household size of families in each of the four groups with season did not show a significant relationship in any of the four groups.

Occupations of gainfully employed homemakers in the four groups are shown in Table 1. Managers, clerks, and kindred workers included occupations such as clerks, stenographers, bookkeepers, cashiers, managers and their assistants. Independent business women included work in a non-farm business (located away from home) owned by her husband as well as businesses owned and operated away from home by women themselves. Professional women included those with occupations such as teachers, trained nurses, home demonstration agents. Skilled workers included occupations such as beauty parlor operators, inspectors, supervisors and foreladies in manufacturing shops. Semi- and unskilled workers included occupations such as waitresses, practical nurses, cooks, laundresses, factory operatives, telephone operators.

The majority of women in all four groups of 135 families each had been married 11 or more years but the minority in all groups had been gainfully employed this long as is shown:

Group*	Married 11 or more years	Having gainful work 11 or more years since marriage
	Percent	Percent
White urban	69	28
White rural	77	19
Negro urban	78	48
Negro rural	79	48

*In this tabulation as well as those that follow there were 135 families in each group.

Differences in years married and years employed since marriage were greater for white than for Negro women—especially white rural women

Table I. Occupations of gainfully employed homemakers in white and Negro urban and rural families.

Occupations	White urban	White rural	Negro urban	Negro rural
	Percent	Percent	Percent	Percent
Managers, clerks and kindred workers	36	27	4	0
Independent business women	8	4	2	1
Professional women	19	8	16	4
Skilled laborers (non-farm)	4	7	1	0
Semi-skilled and unskilled laborers (non-farm)	33	52	68	55
Farm laborers	0	2	9	40
Number of families	135	135	135	135

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[5] In an analysis of variance the F values for testing significance of differences in incomes for the different seasons was for urban whites .4990; for rural whites .1421; for urban Negroes .4711, and for rural Negroes 4.0459. Seasons for rural Negroes was significant at the 2.5% - .5% level.

who presumably have most recently entered the labor market. (See tables 1 and 2 in the Appendix).

Information was obtained on the main occupation of husbands of gainful women. These occupations are shown in Table II.

The main occupation of only 12 percent of the rural white husbands and 16 percent of the rural Negro husbands was farm operation. However, 27 percent of the former group and 23 percent of the latter group actually operated a farm. One cannot look on these rural families with gainfully employed wives as a group of farm families with wife having off-farm work. Only one in four of these rural families operated a farm. It might be noted at this point that 34 of the 36 white farm operators in the rural areas were farm owners, that 11 of the 31 Negro farm operators in these areas were farm owners.

The majority of homemakers in all four groups were 30—49 years of age as is shown:

Group	Under 30 years	30 - 49 years	50 years and over
	Percent	Percent	Percent
White urban	22	66	12
White rural	22	70	8
Negro urban	10	69	21
Negro rural	14	63	23

Ages of Negro urban and rural homemakers and of white urban homemakers cooperating in the three seasons were about the same. White rural homemakers, however, in the fall sample had more younger and older women and fewer in the 30—49 year group than did those in the winter and late spring-early summer samples.[6]

Husbands of these gainfully employed homemakers were on the whole older than were their wives (See Table 3 in the Appendix.) There were fewer husbands under 30 years and more 50 years and over.

The four groups of homemakers varied greatly as to grade in school finished. Urban white and Negro women had more schooling than rural white and Negro women (Table III).[7]

The husbands in these gainful wife families had somewhat less schooling than the wives did (See Table 4 in the Appendix). However, there were slightly more husbands with college training in the white urban group than wives with such training.

Homemaking Activities and Participation of Family Members

White women, both rural and urban most often said they enjoyed food activities such as cooking, canning and meal planning. Negro women most often mentioned house cleaning, both general and specific. A few women frankly stated they enjoyed no housework (See Table 5 in Appendix).

The types of household activities most often saved up for weekends were washing, cleaning, ironing. More mentioned sewing than food preparation or menu making. In fact, few mentioned menus or cooking (See Table 6 in the Appendix).

Table II. Main occupation of husbands of gainfully employed homemakers in white and Negro urban and rural families.

Main Occupations	White urban	White rural	Negro urban	Negro rural
	Percent	Percent	Percent	Percent
Managers, clerks, and kindred workers	31	11	1	1
Independent business men	13	8	4	1
Professional men	8	3	4	1
Skilled laborers (non-farm)	21	30	11	7
Semi-skilled and unskilled laborers (non-farm)	19	33	60	39
Farm operators	1	12	1	16
Farm laborers	0	1	11	31
No occupation	3	2	8	4
College student	4	0	0	0
Number families	135	135	135	135

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[6] In Chi-square tests X^2 values were for: urban whites 3.4238; rural whites 12.6271; urban Negro 6.038; and rural Negro 6.324.

[7] A Chi-square test was made on schooling of homemaker and season in which study was made. The relationship was not significant.

Table III. Schooling of gainfully employed homemakers in white and Negro urban and rural families.

Schooling	White urban	White rural	Negro urban	Negro rural
	Percent	Percent	Percent	Percent
8th grade or less	6	18	43	33
9 - 11 grades	11	32	38	19
High school graduate	50	22	10	18
College training	77	10	7	6
Number families	135	135	135	135

Rural gainful homemakers both white and Negro had more children than did urban gainful homemakers. The percentages of women having one or more pre-school and one or more school children were as follows:

Group	With pre-school children	With school children
	Percent	Percent
White urban	25	51
White rural	33	64
Negro urban	28	49
Negro rural	42	64

White urban homemakers when questioned about who fed and looked after pre-school children when they were away most often mentioned a maid (for summer as well as for winter). A maid was also important in white rural homes of this type but much less so. In white rural families as well as in urban and rural Negro families, relatives nearby or in the home played a much more important part. (See table 7 in Appendix).

When mothers were asked who checked on the school child's eating when she was away most of them said "school" for the winter period. About one-fourth in each group answered "child himself" for the summer period. Child's father was mentioned in summer time by more white than Negro women; older brothers and sisters by more Negro than white women. The fact that the mother was home in summer time or came home to lunch, was mentioned by a number with school children, especially in the white urban group. Maids were mentioned by only 20 percent of the white urban women and 15 percent of the white rural women in connection with school children in summer (See Table 8 in the Appendix).

All except four of the 540 gainful homemakers usually spent some time in food preparation or in dishwashing or both on a weekday. Time spent usually ranged from one to two hours. The average number of minutes spent by those spending was for white urban women 104 minutes, for white rural women 109 minutes, for Negro urban women 97 minutes, and for Negro rural women 112 minutes.

These gainful homemakers varied considerably as to where they took their meal when at work (See Table 9 in Appendix). White urban women most often came home to the meal or waited until they finished work to eat. For the white rural group buying lunch near work at a cafe or lunch room, and taking a lunch from home were most important. For Negro women in both groups "given the meal" was most common. This is related to the fact that most of the Negro women were engaged in domestic service where meals are usually given as part of the pay. Taking a lunch was more common among both white and Negro women in the rural than in the urban group.

In the majority of families the wife did not prepare all meals. The percentages not preparing all meals in the four groups were: rural white 79 percent, urban white 74 percent, urban Negro 68 percent, and rural Negro 63 pecent. The most common practice in white families both urban and rural in which the wife did not prepare all meals was for other members to buy the meal at a lunchroom or cafe, or have the meal prepared by a maid. (See Table 10 in the Appendix). In Negro families, both urban and rural, meals not prepared by wife were most often prepared by others.

What percentage of homemakers in

each of these four groups of 135 families had assistance in food preparation or dishwashing or both from husband, school children and hired help? These percentages were:

Group	Husband	School children	Hired help
	Percent	Percent	Percent
Urban white	50	23	51
Rural white	46	42	28
Urban Negro	38	33	5
Rural Negro	35	49	0

Husbands were an important source of assistance in all four groups but of somewhat less importance in the Negro rural group. This difference is probably related to the fact that 64 percent of the Negro rural families had one or more children in school and in 77 percent of these families school children helped in food preparation or dishwashing or both. In Negro rural families average time per weekday spent by school children who spent time was 52 minutes. (See Table 11 in the Appendix).

Fifty-one percent of the white urban families had school children and in 45 percent of these families school children helped in food preparation or dishwashing or both. Average time per week spent by school children in white urban families who spent time was 39 minutes per week day. (See Table 11 in the Appendix). This was the group with more hired help.

Urban white and rural white families with hired help had such help an average of 27 hours a week. No Negro rural family had hired help but the few Negro urban families with hired help averaged 28 hours a week.

Husbands in each group who assisted in food preparation or dishwashing or both spent an average of about 30 minutes daily in these activities.

Practically all families had shopped for food during the week preceding the interviews. Someone had shopped in 99 percent of the white urban and in 97 percent of the white rural families. Food shopping had been done in 93 percent of the Negro urban and in 83 percent of the Negro rural families. The wife alone was the member who had usually done the shopping. (See Table 12 in the Appendix). Husbands had done food shopping or helped do it in more Negro than white families.

Types of Meals Served

Homemakers were asked to give menus served at breakfast, noon meal and evening meal on the last weekday preceding the interview. The menus served at each of these three meals were classified into 6 groups as follows: (1) Regular family meal—4 items or less; (2) Regular family meal—5 items or more; (3) Mostly leftovers; (4) Mostly sandwich or salad type; (5) Meals or special foods for baby or ill persons with or without family meal; (6) Meal not served.

The most typical breakfast and evening meal of white families in both urban and rural areas was a regular family meal with 5 or more items. With Negro families for these meals it was a regular family meal of 4 or less items.

There was no typical meal at noon. The sandwich salad type was served by more families in toto, but it was considerably less important for the rural Negro family than the regular family meal of 4 items or less. (See Table 13 in the Appendix).

The traditional pattern for the evening meal—leftovers from the noon meal—was not used by more than one in ten of these gainful wife families. The gainful wife family has its dinner meal in the evening which is a characteristic of an urbanized society.

Baking Practices

Homemakers were asked about home baking practices during the 7 days preceding the interview, i.e. about batters and doughs mixed, the number of times made and number of times made from a purchased mix during this period.

The percentage of families in each of the four groups mixing batters and doughs of specified kinds during the report week is shown in Table IV.

Cornbread and biscuit are still popular with all groups but the white urban

Table IV. Percent of white and Negro urban and rural gainfully employed homemaker families mixing batters and doughs during the report week.

Kinds of batters and doughs	White urban	White rural	Negro urban	Negro rural
	Percent	Percent	Percent	Percent
Cornbread	70	84	89	93
Biscuit	50	79	80	88
Cake, gingerbread	31	38	34	35
Pie, pastry	35	26	18	24
Waffles, griddle cakes	19	23	8	6
Cookies	12	4	2	4
Muffins	8	1	3	1
Bread, rolls	1	6	7	3
Number families	135	135	135	135

group seems to have given up biscuit making to some extent. About one-third of the families in all groups had made cake during the report week. A study was made of the data to determine if baking varied with season but no such variation was found.

The big difference in baking patterns of the non-gainful rural white homemaker of the 1956 study (previously referred to) and the gainful rural white homemaker in this study is in percentages making pastry and cake. These activities were much more common among the non-gainful rural woman. The biggest difference in rural gainful homemakers in the two studies was the percentage making biscuit (100 percent in 1956 study, 79 percent in this study). The difference between use of biscuit by these two groups is greater than is the difference between use of cornbread (91 percent and 84 percent). In a previous study a highly significant relationship was found in use of cornbread and use of two popular Southern vegetables—cowpeas and turnip greens. It may be that cornbread is less easily substituted for other bread than is biscuit.[8]

Table 14 in the Appendix shows the average number of batches of doughs and batters made during the report week in homes of those making. Negro families who made cornbread and biscuit during the report week made these breads more times than white families who made the breads. An average of from 4 to nearly 7 batches of cornbread and biscuits were made during the report week by different groups who reported making. White urban families made fewer batches; Negro rural more batches. The average number of batches of other baked products made by families making ranged from 1 to 2.5 times.

Of all the batches of doughs and batters reported made during the week by white women only 6 percent were made with mixes—only one percent of those reported by Negro women were made with mixes. The small proportion of mixes used is related to the fact that most doughs and batters were cornbread and biscuit which are rarely made with mixes. Canned biscuits were used by a number of families, especially white urban families. Use of mixes by urban and rural women did not differ to any extent. Cake mix was the type most commonly used. It was used in about 40 percent of the batches of cake baked in homes of white homemakers; in about 22 percent of the batches of cake baked in homes of Negro homemakers. Fewer families had made griddle cakes and waffles than had made cake or gingerbread or both. But of those reporting having made griddle cakes and waffles about two-thirds of the white women and one-third of the Negro women had used a mix. Relatively few reported use of pie pastry mix during the report week.

Home Production and Processing

Homemakers were asked if during the past year their family had produced for their own use any poultry, eggs, milk, meat, vegetables. Replies to this question are summarized in Table V.

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[8] Menu Patterns in the Delta Cotton Area. Dorothy Dickins and Beulah Gillaspie. Journal of Home Economics, March, 1953.

Table V. Food produced at home for family use by white and Negro urban and rural gainfully employed wife families.

Food	White urban	White rural	Negro urban	Negro rural
	Percent	Percent	Percent	Percent
Poultry	3	29	19	57
Eggs	3	25	19	56
Milk	2	25	3	21
Meat	6	30	13	34
Vegetables	16	51	48	60
Number families	135	135	135	135

Table VI. Kinds and methods of food preservation for home use by white and Negro urban and rural gainfully employed wife families.

Kind and Method of Food Preservation	White urban	White rural	Negro urban	Negro rural
	Percent	Percent	Percent	Percent
Canning, all kinds	53	27	55	41
Freezing vegetables or fruits or both	55	31	15	14
Freezing meat	41	21	14	12
Jelly, preserves, jam	55	44	36	47
Pickle	25	22	22	24
Number families	135	135	135	135

Some of the urban families, especially those on the edge of town, carried on limited home production of food. A number had a few vegetables during several months in the year. Some kept a few hens or a hog or two. Vegetable production was the type of food production carried on most often by all four groups of gainful wife families. Relatively more Negro than white families carried on food production.

The percentage of rural families both white and Negro producing poultry, eggs, milk, etc. for family use was much lower than the percentage of young white and Negro farm-operator families studied in 1958 producing such foods for home use.[9] It would thus seem that one characteristic of the gainful wife rural families is a shift away from home production.[10]

Fifty-six percent of the white rural families had a home freezer or rented a locker or both. The percentage with such facilities for white urban families was 33. For Negro rural families it was 19 percent and for Negro urban families 16 percent.[11]

When asked, "Did you can, freeze or preserve any foods during the past year?" the majority of homemakers in all groups replied "yes." These percentages were for white rural families, 77; for white urban families, 58; for Negro rural families, 64; and for Negro urban families, 57.

Kinds of food and method of preserving carried on during the past year are shown in Table VI. As will be noted, making jelly, preserves, jam, and canning were the two most generally used methods of preservation. Freezing of vegetables and/or fruits was done slightly more than freezing meat. There was a bigger difference in preservation by white rural and urban families than there was in preservation by Negro rural and urban families. Table 15 in the Appendix gives the average amount of these products canned, frozen and preserved by those engaging in such activities. Amounts of food preserved for home use were less in these rural families than studies conducted in 1956 and 1958 (see footnotes 9 and 10 for references of these studies).

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[9] Levels of Living of Young Farm-Operator Families. Dorothy Dickins. Miss. Agr. Exp. Sta. Bull. 579 & 580, 1959.

[10] Differences were also found in production of food for home use of gainful and non-gainful rural white families of the 1956 study, "Food Use and Gainful Employment of the Wife." Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. 558, May, 1958.

[11] Sixty-seven percent of the rural whites; 50 percent of the rural Negroes; 69 percent of the urban whites and 49 percent of the urban Negroes had a freezing compartment in their refrigerators.

Food and Related Facilities

Rural families had poorer facilities for hearing about, for shopping and preparing food than did urban families (See Tables 16 and 17 in the Appendix.) The majority of families in all four groups owned a gas or electric cook stove, an electric refrigerator, an auto and a radio. The majority in all groups except rural Negroes had running hot and cold water in the house and a kitchen sink. The majority in both groups of white families owned an electric mixer, a pressure canner or saucepan, a telephone, a TV set and an electric coffeemaker.

The biggest difference in facilities of these rural white and Negro gainful wife families and the group of young farm-operator white and Negro families previously studied was in hot and cold water piped into the house. It was much more frequent in the gainful wife group.[12] However, there was relatively more difference in rural gainful wife Negro families and the farm-operator Negro families than there was in rural gainful wife white families and the farm-operator white families.

Meals Served and Other Food Eaten During Report Week

During the report week rural families served more meals from the home supply than did urban families. The average number of meals served to family members and to other persons such as boarders, guests, hired help during the report week was as follows:

Group	Meals to family members	Meals to other persons
	No.	No.
White urban	62.12	4.24
White rural	72.76	4.52
Negro urban	72.92	1.21
Negro rural	100.85	1.00

No relationship was found in number of meals served and season.

In about three-fourths of the white families and one-half of the Negro families one or more meals had been purchased during the report week at a lunchroom, cafe or restaurant.[13] The average number of meals per family purchasing was greatest for the two rural groups—10.03 for the rural whites and 8.10 for the rural Negroes. For the two urban groups it was 7.64 meals for the urban white and 6.64 for the urban Negroes. Average expenditures for these meals were for urban white families $4.03, for rural white families $4.74, for urban Negro families $2.18 and for rural Negro families $2.39. This makes an average expenditure of about 50 cents per meal for the whites and of about 30 cents per meal for Negroes.

Members in Negro families received more gift meals than members in white families. As previously mentioned a number of the Negro women were engaged in domestic service and received a meal while on the job. The average number of gift meals received per family receiving was for the urban white group 1.50; for the rural white group 1.60; for the urban Negro group 5.07; and for the rural Negro group 3.87. Members in a few families received gift meals while visiting relatives and friends. The percentage of families in which one or more members received gift meals ranged from 23 percent in the rural white group to 62 percent in the urban Negro group. The percentage for the urban white group was 27 and for the rural Negro group 44.

During the report week most families had expenditures for snacks (84 percent for both white urban and rural families, 67 percent for Negro urban families and 49 percent for Negro rural families.) Snacks included soft drinks, coffee, salted nuts, ice cream and the like eaten between meals or with a lunch of foods taken from the home supply. Average expenditures during the report week for snacks per family having this expense were for urban white families $1.90; for rural whites $1.57; for urban Negroes $1.13 and for rural Negroes $.57.

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[12] See reference footnote 9.

[13] In 73 percent of the urban white families, 80 percent of the rural white families, 49 percent of the urban Negro and 50 percent of the rural Negro famiiles one or more meals had been purchased at a lunchroom or cafe, etc.

Nutritive Value of Foods Used

How well did the diets of the four groups of families whose food records form the basis of this study meet standards of good nutrition? This question can be answered, in part, from calculations made to find the approximate food energy values and quantities of protein, calcium, iron, vitamin A value, thiamine, riboflavin, niacin and ascorbic acid available to each family. The results were compared with the Recommended Dietary Allowances of the National Research Council, hereafter called NRC allowances. The allowances for the physically active man 21 to 34 years old, 69 inches in height and 160 pounds in weight, were considered equal to one nutrition unit, and the allowance for persons of different sex, age, and physical activity were expressed as relatives of the man's allowance. Values per nutrition unit mean that for each 3000 calories, 75 grams of protein, .8 grams of calcium, etc., recommended, the indicated amounts were supplied by the diets. The average supply of nutrients in the diets of all four groups furnished more of each of these nutrients than NRC allowances, except ascorbic acid in the rural Negro group. (See Table 18 of the Appendix.)[14]

Moreover, average nutrients received by each group in each of the three seasons met standards, except the rural Negro family in winter. This family had an average of 71 milligrams of ascorbic acid in winter. Average amounts of ascorbic acid for fall and spring were 76 milligrams or slightly above the standard 75 milligrams.

Average values, however, may conceal variations in the supply of nutrients individual families had during the report week. Tabulations were therefore prepared showing percentage of white and Negro rural and urban families which had diets furnishing 2/3 or more of the NRC allowance for given nutrients. This amount is usually regarded as beyond the point where the supply of that nutrient presents a serious problem. As will be noted, from Table VII there were fewer families whose diets furnished two-thirds or more of NRC recommendations in ascorbic acid than in any other nutrient. Differences in such shortages by seasons were statistically significant in only two nutrients (in ascorbic acid for white rural families and in calcium for Negro rural families).

Diets of families in this study follow the general pattern of those in other areas—that is, to show more shortages in ascorbic acid, vitamin A value and calcium.

Cost and Money Value Of Food Used

Families in this study obtained foods by purchase, by home production and as a gift. As will be noted from Table VIII most of the food was obtained by purchase.

Table VII. Percentage of white and Negro urban and rural families with wife gainfully employed who had 2/3 or more of NRC recommendations during the report week.*

Nutrient	135 White urban families	135 White rural families	135 Negro urban families	135 Negro rural families
Energy	100	99	98	93
Protein	100	99	94	91
Calcium	99	99	80	76
Iron	100	100	97	96
Vitamin A	98	93	90	82
Thiamine	100	99	97	95
Riboflavin	100	97	92	90
Niacin	100	100	99	95
Ascorbic acid	93	86	70	61

*Percentage of white rural families with 2/3 or more of NRC ascorbic acid recommendations were in fall 76 percent, in winter 91 percent, and in late spring-early summer 91 percent. Percentage of Negro rural families with 2/3 or more of NRC calcium recommendations were in fall 91 percent, in winter 69 percent, and in late spring-early summer 69 percent.

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[14] Quantities of food consumed by households or available for consumption were multiplied by figures for the nutritive value of foods in terms of energy, protein and seven other nutrients. A duplicate set of nutritive value cards used in the Household Food Consumption Survey of 1955 of the Agricultural Research and Marketing Service of the U. S. Department of Agriculture was purchased from National Analysts, Inc., by whom data were collected and tabulated for these government agencies. The cards gave nutritive values per pound.

Table VIII. Average expense of purchased food, average value of home produced food and gifts and average cost plus money value of food used during the report week by urban and rural white and Negro gainfully employed wife families.

Item	White urban	White rural	Negro urban	Negro rural
	dollars	dollars	dollars	dollars
Expense of purchased food	21.14	23.31	13.69	15.67
Value home-produced food and gifts of food	2.61	.89	2.97	1.20
Average cost plus money value food used	23.75	24.20	16.66	16.87
Number of families	135	135	135	135

Home produced foods used by the family were valued at the price the family would have received for the food if they had sold it. Prices compiled by the Marketing Service of the United States Department of Agriculture for Mississippi were used as far as was possible. However, these compilations did not include some of the foods produced and consumed by the 540 families. For these, prices received by local farmers in the study area during 1958-60 were collected and the most typical used. Foods received as gift were valued like home produced food when possible; foods generally purchased such as dried milk, oranges, etc. were valued at retail prices.

Average cost plus money value of food used per capita during the report week ranged from $7.66 for white urban families to $3.51 for rural Negro families. It was $6.45 for rural white families and $4.78 for urban Negro families.[15]

Kinds and Amounts Of Foods Used

In Table 19 in the Appendix is shown the per capita consumption of different types of foods during the report week by the four groups of gainful wife families. Such consumption varied widely. Per capita use of milk products (including fluid milk equivalent of evaporated condensed and dry milk, cream, and ice cream) during the report week ranged from 3.0 quarts by urban Negro families to 5.2 quarts by white rural families.

The use of milk products by households is of special interest because milk contributes nutrients which are not supplied by other food items in as liberal quantities or in as favorable combinations.

For most types of foods, however, consumption per capita was less for the rural than for the urban group as, for example, meat, fish, poultry, fruits and vegetables (except dried). Consumption of eggs was the same for white urban and rural families. But Negro urban families consumed more eggs per capita than Negro rural families.

White urban families whose consumption of most types of foods was higher than any other group, consumed less flour, cornmeal and cereal foods than the other three groups but more bakery products. Consumption per capita of sugar and other sweets and of fats and oils was about the same for all groups.

New forms of food were used in larger amounts by urban white families, next by rural whites, then by urban Negroes and last by rural Negroes. Thus per capita consumption of juices was 1.2 pints for urban whites, .6 pint for rural whites, .3 pint for urban Negroes and .1 pint for rural Negroes. During the report week the following percentages of families used ground and instant coffee:

Group	Ground coffee	Instant coffee
White urban	64	33
White rural	70	24
Negro urban	61	20
Negro rural	70	7

Another illustration in use of newer forms of food by the four groups is the use of one of the newer kinds of bakery products. During the report week 39 percent of the urban whites, 33 percent of the rural whites, 17 percent of the urban Negroes and 5 percent of the rural Negroes used brown 'n serve rolls. The percentages using canned and frozen biscuits were 41, 23, 7, and 4 respectively. Use of frozen meat, fish or poultry pies was limited to white families. Thirteen percent of the white urban and 6 percent of the white rural families had used it during the report week.

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[15] An analysis of variance on total cost plus money value of food used during the report week by families in each of the 4 groups with season did not show a significant relationship in any of the four groups.

Tables 20, 21, and 22 in the Appendix show differences in number of families in the four groups using specified foods during the winter, late spring-early summer and fall studies. This comparison is limited to foods which, according to Chi-square tests, showed significant differences at the 1% level in percentages using.

There was not as much seasonal variation in per capita use of purchased foods of different types as had been expected. Most of the variations lay in specific foods rather than in food of a particular type. The urban homemaker's family had fewer foods that she might label "to be bought" for this particular season than did the rural homemaker's family. For example, oranges, apples, and bananas were used by significantly more rural white families in winter than in late spring-early summer or fall. Purchased fresh tomatoes were used by significantly more rural white families in late spring-early summer than in fall and winter. This was not the case with urban white families. It may be that the white families are following patterns used before they had full time gainful work away from home and had given up some home production. Habit may play a part here.

There were, however, certain seasonal foods purchased by more families in all groups in certain seasons, such as fresh string beans and strawberries in late spring-early summer.

Conclusions

According to the 1960 census of population the urban white population in Mississippi is increasing at a more rapid rate than is the rural white or the urban Negro. The Negro rural population is decreasing.[16] By 1970 it has been predicted that there will be further increases in urban whites, further decreases in rural Negroes. There may be small gains in rural whites and urban Negroes. There will be more homemakers working away from home.

The food producer, food processor as well as the home economist needs to know more about this market—this market in which gainful wife families will be increasingly important. One safe prediction is an increase in foods such as are used by urban white families with wife gainfully employed. This means more meat, fish, poultry; more fruits and vegetables. This means more ready-prepared or partly prepared foods—less home baking.

With ever increasing rural homemakers in gainful work away from home there will be less food produced for home consumption. There will be a lag, however, on the part of rural families with wife gainfully employed in change of food habits.

Gainful work away from home will mean a shift by more families of the main meal from noon to evening. It will mean changing menu patterns. It will mean greater use of purchased meals for cafes, lunchrooms, restaurants.

Men and boys will play an increased role in food activities.

Implications for Producers And Processors

Producers and processors can gain in three ways from changes brought on by more homemakers having gainful work away from home: (1) From the increases in urban white population of the state, which group uses a greater variety of purchased foods and more processed foods. (2) From less home production for family consumption on the part of rural families in which the wife is gainfully employed. (3) From an increased market for food from institutions such as cafes, restaurants, and lunchrooms.

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[16] Population of Mississippi counties and cities 1950 to 1960, Preliminary Report in Sociology and Rural Life, No. 14, September, 1960.

Rural families of this study used larger amounts of dairy products, yet relatively few had a milk cow. Many of these families purchased their milk products. Producers and processors should note this tendency and make milk products more readily available to rural families.

It would seem important that producers and processors work closely with (1) home economists who assist families not only to get foods that will furnish nutrients needed for health and energy, but also to help them get more palatable and attractive food: (2) rural families who are shifting from an economy of food production to purchased foods. Techniques might well be found for speeding up the lag in changing food habits.

Implications for Home Economists

(1) Continued emphasis on foods needed for an adequate diet including special emphasis on foods rich in ascorbic acid (such as citrus fruit, raw leafy vegetables, tomatoes), vitamin A (yellow and green vegetables, whole milk, eggs, liver, milk fat), and calcium (milk products).

(2) Training for men and boys to assist them in playing their new role of assisting with the family food.

(3) Help in selecting meals at restaurants, lunchrooms and in planning lunches that will fit in with the other two meals served at home.

(4) Training in planning meals that are palatable but require the minimum time in preparation. What kind of equipment is needed for time-saving meals? What are desirable short cuts in cooking?

(5) Getting homemakers and families to examine and understand their own food habits.

(6) Working with producers and processors that more adequate palatable food be provided.

APPENDIX TABLES

Table 1. Percentage of white and Negro urban and rural gainfully employed homemakers by number of years employed since marriage.

Groups	No. home-makers	Years employed since marriage: Percent					
		1 year or less	2 - 4 years	5 - 10 years	11 - 20 years	21 - 30 years	31 years & over
Urban white	135	17	19	36	24	4	0
Rural white	135	16	24	41	17	1	1
Urban Negro	135	4	18	30	31	12	5
Rural Negro	135	10	21	21	34	12	2

Table 2. Percentage of white and Negro urban and rural gainfully employed homemakers by years married.

Groups	No. home-makers	Years married, Percent					
		1 year or less	2 - 4 years	5 - 10 years	11 - 20 years	21 - 30 years	31 years & over
Urban white	135	3	7	21	39	23	7
Rural white	135	1	6	16	48	21	8
Urban Negro	135	1	5	16	38	27	13
Rural Negro	135	0	7	14	39	30	10

Table 3. Percentage of white and Negro urban and rural husbands of gainfully employed homemakers by age.

Group	No. husbands	Age of husband: Percent		
		Under 30 years	30 - 49 years	50 years and over
Urban white	135	14	65	21
Rural white	135	12	67	21
Urban Negro	135	4	62	34
Rural Negro	135	8	54	38

Table 4. Percentage of white and Negro urban and rural husbands of gainfully employed homemakers by schooling.

Group	No. husbands	Schooling of husband: Percent			
		8th grade or less	9 - 11 grades	H. S. graduate	With college training
Urban white	135	8	20	33	39
Rural white	135	21	27	38	14
Urban Negro	135	57	18	15	10
Rural Negro	135	79	12	8	1

Table 5. Percentage of white and Negro urban and rural gainfully employed homemakers* by kinds of homemaking activity enjoy most.

Homemaking** Activities	White urban	White rural	Negro urban	Negro rural
	Percent			
Cooking, canning, meal planning	38	42	33	27
Cleaning house (general or specific activities)	24	30	44	38
Sewing	27	27	15	10
Ironing	1	0	0	7
Yard work	5	4	6	3
Washing	1	1	0	10
None	7	4	4	8
No preference	4	3	0	6
All other***	10	3	9	1

*There are 135 families in each of the 4 groups in this table and others to follow unless otherwise specified.

**Adds up to more than 100 percent as some named more than one.

***Knitting, quilting; activities with children; decorating home; gardening; entertaining were other activities named.

Table 6. Percentage of white and Negro urban and rural gainfully employed homemakers by kinds of homemaking activities save for weekend.

Homemaking* activities	White urban	White rural	Negro urban	Negro rural
	Percent			
Cleaning	54	51	45	36
Washing	14	38	41	64
Ironing	16	26	16	44
Cooking, menus	14	10	10	5
Sewing	11	13	10	12
None	26	11	15	11
All other**	4	4	1	0

*Adds up to more than 100 percent as some named more than one.

**Social obligations; house decoration; garden, yard work and shopping were other activities named.

Table 7. Percentage of white and Negro urban and rural gainfully employed homemaker families with preschool children by who feeds and looks after children when mother is away.

Who feeds and looks after children*	34 white urban	45 white rural	38 Negro urban	57 Negro rural
IN WINTER:	Percent			
Maid	68	29	8	0
Kindergarten or nursery	15	13	8	5
Goes with mother to work	3	2	0	5
Relative nearby	6	13	21	25
Baby sitter's home	6	4	18	18
Child's mother home all meals	0	11	8	21
Child's dad	9	13	3	0
Older sister or brother	0	2	8	4
Adult relative living in home including male as well as female	0	9	26	25
IN SUMMER:				
Maid	65	29	8	0
Baby sitter's home	12	7	18	12
Goes with mother to work	3	2	0	11
Relative nearby	3	18	16	21
Kindergarten or nursery	9	4	5	5
Child's dad	6	16	5	0
Older brother or sister	3	11	18	26
Adult relative at home	0	13	26	25
Child's mother home all meals	6	2	11	4

*Some named more than one source.

Table 8. Percentage of white and Negro urban and rural gainfully employed homemaker families with school children by who checks on child's eating when mother is away.

Who checks on child's eating*	69 white urban	86 white rural	66 Negro urban	86 Negro rural
IN WINTER:		Percent		
School**	78	94	73	69
Child's father	6	3	5	2
Mother home mealtimes	9	0	2	8
Self	0	1	5	6
Older brother or sister	0	1	6	7
Older person in home	3	1	6	7
Maid	3	0	1	0
Relative nearby	1	0	2	1
IN SUMMER:				
Self	22	24	26	29
Child's father	17	19	6	14
Mother home mealtimes	30	10	15	8
Baby sitters or neighbor	1	2	9	3
Relative nearby	4	15	15	13
Goes to work with mother	0	1	1	5
Maid	20	15	1	2
Older brother and sister	0	12	18	18
Older person in home	9	6	8	8

*Sometimes more than one named.

**Mothers assumed school checked on child's lunch.

Table 9. Percentage of white and Negro urban and rural gainfully employed homemakers by where take meal when at work.

Where take meal	White urban	White rural	Negro urban	Negro rural
		Percent		
Eat at home or eat when return	49	20	14	21
Take lunch	19	30	10	21
Buy lunch near work	22	39	16	16
Given a meal	9	8	59	40
Buy sometimes, bring lunch sometimes	1	3	1	1
Other combinations	0	0	0	1

Table 10. Percentage of white and Negro urban and rural gainfully employed homemaker families with homemaker not preparing all meals by who prepared meals not prepared by her.

Who prepared other meals	107 white urban	100 white rural	92 Negro urban	85 Negro rural
		Percent		
Bought	34	32	25	26
Husband	14	16	27	28
Maid and bought	5	1	0	0
Maid	23	20	5	0
Older daughter or female relative	9	17	23	27
Two meals eaten only	4	3	5	2
Older daughter and female relative	0	0	2	2
Bought and older daughter and female relative	1	3	3	0
Husband and another family member	5	1	2	3
Husband and maid	2	2	0	0
Son or boys	0	0	3	2
Husband and bought	0	0	2	4
Bought and ate 2 meals a day	1	2	2	0
All other	2	3	1	4

Table 11. Percentage of white and Negro urban and rural gainfully employed wife families with one or more school children, percentage with school children whose children assist with food preparation, dishwashing or both, average number of minutes assistance on a weekday by those in families assisting.

Group	Percent with one or more children in school	Percent with school children whose children help with preparation or dishwashing	Average number minutes spent by school children during a weekday in families with children spending time
White urban	51	45	39
White rural	64	66	47
Negro urban	49	68	52
Negro rural	64	77	52

Table 12. Percentage of white and Negro urban and rural gainfully employed wife families in which there had been shopping for food the week preceding the interview, classified by who did food shopping.

Who did shopping	134 white urban	131 white rural	126 Negro urban	112 Negro rural
		Percent		
Wife	71	75	63	62
Husband	7	11	18	23
Daughter	1	0	3	1
Wife and other female in family	5	3	3	1
Husband and wife	14	11	11	12
Other combination	2	0	2	1

Table 13. Percentage of white and Negro urban and rural gainfully employed wife families by type of meal served at breakfast, noon meal and evening meal last weekday preceding interview.

Type of menu	White urban	White rural	Negro urban	Negro rural
BREAKFAST:		Percent		
Regular family meal 4 items or more	19	19	63	55
Regular family meal 5 or more items	75	76	33	41
Mostly left overs	0	0	3	1
Mostly sandwich or salad type	0	0	0	1
Special meals with or without regular meals	5	6	1	0
Meal not served	1	0	0	1
NOON MEAL:				
Regular family meal 4 items or less	9	7	22	33
Regular family meal 5 or more items	30	19	10	10
Mostly left overs	6	9	14	16
Mostly sandwich or salad type	29	34	24	19
Special meals with or without regular meals	19	7	4	5
Meal not served	16	24	25	16
EVENING MEAL:				
Regular family meal 4 items or less	21	9	46	52
Regular family meal 5 or more items	54	73	38	29
Mostly left overs	9	11	9	14
Mostly sandwich or salad type	10	1	3	3
Special meals with or without regular meals	4	5	4	1
Meal not served	1	0	1	1

Table 14. Average number of batches of batters and doughs made during week preceding interview by gainfully employed wife families making, classified by urbanization and race.

Batters and doughs	Average number batches by			
	White urban	White rural	Negro urban	Negro rural
Cornbread	4.2	4.4	5.4	6.7
Biscuit	4.0	5.7	5.0	6.5
Cake, gingerbread	1.1	1.1	1.0	1.1
Pie, pastry	1.4	1.7	1.3	1.5
Waffles, griddle cakes	1.3	1.3	1.1	1.6
Cookies	1.4	1.2	1.3	1.5
Muffins	2.3	1.0	2.3	2.5
Bread, rolls	1.5	1.9	1.6	1.4

Table 15. Average amount of foods canned, frozen or preserved during the past year by gainfully employed wife families canning, freezing or preserving, classified by urbanization and race.

Item	White urban	White rural	Negro urban	Negro rural
No. quarts canned	75	78	59	59
No. pints, fruits and vegetables frozen	169	230	151	272
No. lbs. meat, poultry, fish frozen	113	215	135	168
No. jars preserves, jellies	33	36	22	24
No. quarts pickles, relishes	16	22	15	15

Table 16. Percentage of white and Negro urban and rural gainfully employed homemaker families classified by ownership of specified food facilities and equipment.

Facilities and equipment	White urban	White rural	Negro urban	Negro rural
Water facilities in home:	Percent having			
Running cold	1	6	16	15
Running hot and cold	99	88	56	21
Pump	0	0	0	2
None	0	6	28	62
Kitchen sink	99	94	66	35
Cook stove:				
Electric	34	35	11	4
Gas	66	63	74	49
Wood	0	2	13	46
Kerosene	0	0	2	1
Electric mixer	74	65	20	8
Pressure canner or saucepan	51	51	18	10
Telephone	80	64	43	21
Radio	84	83	83	64
Television	88	81	55	39
Electric dishwasher	7	6	0	0
Garbage disposal unit	3	1	0	0
Electric frying pan	34	19	4	4
Electric deep fryer	27	23	4	3
Electric coffeemaker	74	59	18	13
Electric toaster	62	42	15	10
Electric roaster	4	6	1	1
Electric broiler	7	7	0	1
Refrigerator*				
Electric	99	97	87	88
Gas	2	3	1	1
Ice	0	0	2	4
None	0	0	10	7

*One had 2 refrigerators. None had a kerosene refrigerator.

Table 17. Percentage of white and Negro urban and rural gainfully employed homemaker families classified by ownership of autos and trucks, 1958-60.

Group	Auto only	Truck only	Both auto and truck	Neither
	Percent having			
Urban white	77	2	21	0
Rural white	73	4	22	1
Urban Negro	72	5	4	19
Rural Negro	90	5	5	0

Table 18. Average nutritive value of diets per nutrition unit per day from food used at home in a week by white and Negro families in rural and urban areas in families with wife gainfully employed 30 hours or more per week compared with the standard recommended by the NRC.

Nutrients	Unit	Standard	White urban	White rural	Negro urban	Negro rural
Energy	Calories	3000	4850	4960	4670	4140
Protein	Grams	75	133	129	111	98
Calcium	Grams	.8	1.18	1.27	.92	.97
Iron	Milligrams	12	17.9	18.3	17.8	16.7
Vitamin A	Inter. Units	5000	10617	10017	11500	9783
Thiamine	Milligrams	1.5	2.34	2.42	2.28	2.07
Riboflavin	Milligrams	1.9	2.82	2.93	2.39	2.33
Niacin	Milligrams	15	30.0	29.1	28.1	23.3
Ascorbic acid	Milligrams	75	119	101	91	74

Table 19. Per capita consumption during the report week of white and Negro urban and rural families with wife gainfully employed 30 hours or more away from home by type of food used.

Food type	Unit	White urban	White rural	Negro urban	Negro rural
Milk equivalent**	qts.	4.5	5.2	3.0	3.5
Meat, fish, poultry, bacon, salt pork	lbs.	5.1	4.5	4.8	3.5
Eggs	No.	9.6	9.6	6.2	5.3
Flour, cornmeal, cereal foods	lbs.	1.9	2.8	3.6	4.7
Bakery products	lbs.	2.3	1.8	1.3	1.4
Sugar, other sweets	lbs.	1.5	1.8	1.8	1.6
Fats and oils	lbs.	1.2	1.3	1.2	1.1
Potatoes (Irish and sweet)	lbs.	1.5	1.7	1.6	1.3
Fresh vegetables (excluding potatoes)	lbs.	3.2	3.0	2.9	2.3
Fresh fruit	lbs.	2.3	1.8	1.3	1.2
Canned fruits and vegetables	lbs.	1.1	.9	.6	.3
Juices	lbs.	1.3	.7	.3	.1
Dried fruits and vegetables	lbs.	.3	.3	.4	.5
Frozen fruits and vegetables	lbs.	.2	.2	.1	*
Nuts and peanut butter	lbs.	.1	.1	.1	.1
Soup	lbs.	.2	.1	.1	*

*Less than .5%.

**Approximately the quantity of fluid milk to which the various dairy products (except butter) are equivalent in calcium.

Table 20. Number families using purchased foods of specified kinds with highly significant relationship in use and race-urbanization group, winter study. There were 45 families in each group.

Food*	White urban	White rural	Negro urban	Negro rural
Whole milk, homogenized	43	36	32	25
Cheese, American, not processed	13	28	7	16
Cheese, American, processed	14	8	3	0
Butter	13	1	10	2
Margarine	38	40	35	26
Lard, not farm	6	5	26	21
Vegetable fat	29	27	15	12
Salad, cooking oil	22	10	4	2
Mayonnaise	31	36	9	16
Flour, self-rising	6	19	6	7
Cornmeal, not self-rising	11	10	30	34
Grits	8	13	17	25
Macaroni, spaghetti	9	27	11	25
Crackers	30	29	17	15
Rolls, brown 'n serve	17	20	8	4
Biscuits, canned, frozen	22	9	4	3
Tuna fish (canned)	9	18	5	3
Pork back and neck bones	1	1	12	4
Bacon, sliced	38	30	15	8
Bacon, slab	1	4	7	14
Salt pork	6	0	22	17
Jelly	12	18	5	7
Sweetpotatoes	12	10	27	18
Turnip greens, fresh	4	6	16	10
Lettuce	37	33	9	11
Tomatoes, fresh	19	20	7	1
Celery, fresh	22	18	6	6
Oranges	20	28	12	12
Bananas	20	34	12	12
Pineapple, canned	6	12	2	0
English peas, canned	22	18	6	6
Pinto beans, dry	0	3	9	16
Cowpeas, dry	4	6	22	19
Coffee, instant	22	15	12	4
Cocoa	2	16	2	10
Catsup	25	23	7	10
Pickles	20	11	5	2

*Chi-square tests significant at 1% level, including some cases where an expected number was less than five.

Table 21. Number families using purchased foods of specified kinds with a highly significant relation in use and race urbanization group, late spring-early summer study. There were 45 families in each group.

Food*	White urban	White rural	Negro urban	Negro rural
Whole milk, homogenized	43	34	32	18
Buttermilk	15	12	24	8
Ice cream	27	37	19	11
Margarine	40	40	34	23
Lard, not farm	5	5	25	18
Lard, farm	0	0	0	15
Vegetable fat	37	29	17	10
Salad, cooking oil	7	21	6	4
Mayonnaise	31	37	15	16
Cornmeal, not self-rising	9	14	23	26
Bread, white	43	44	42	29
Crackers	23	31	12	8
Rolls, brown 'n serve	18	11	6	1
Biscuits, canned, frozen	17	12	1	1
Tuna fish (canned)	16	13	3	4
Ground beef	31	28	19	16
Ham, cured	15	5	5	0
Bacon, sliced	32	34	21	9
Potatoes, white	38	35	35	23
Sweetpotatoes	6	2	17	4
Carrots	20	11	5	2
Lettuce	39	35	13	12
Tomatoes, fresh	31	31	13	6
Lemons	22	26	17	11
Bananas	30	27	16	12
Pineapple, canned	11	10	0	0
Corn, canned	13	7	1	2
English peas, canned	9	22	8	2
Orange juice, frozen	14	9	0	0
Cowpeas, dry	5	2	15	15
Cola drink, bottled	24	28	11	14
Peanut butter	17	26	12	8
Catsup	13	19	2	5

*Chi-square tests significant at 1% level, including some cases where an expected number was less than five.

Table 22. Number of families using purchased foods of specified kinds with highly significant relationship in use and race-urbanization group, fall study. A total of 45 families in each group.

Foods*	Number of families using			
	White urban	White rural	Negro urban	Negro rural
Whole milk, homogenized	45	28	33	18
Ice cream, bulk pkg.	26	17	21	10
American cheese, processed	19	7	7	0
Margarine	44	36	35	26
Lard, not farm	8	14	22	34
Vegetable fat	29	21	14	4
Salad, cooking oil	16	15	6	3
Mayonnaise	29	24	14	10
Flour, not self-rising	20	6	24	15
Flour, self-rising	18	33	13	23
Cornmeal, not self-rising, bolted	9	8	27	20
Cornmeal, self-rising	24	27	11	22
Grits	6	10	25	9
Crackers	30	19	13	8
Rolls, brown 'n serve	18	13	8	1
Biscuit, canned or frozen	17	10	4	1
Tuna fish, canned	13	13	8	0
Stew beef	4	6	19	11
Ground beef	33	24	17	16
Ham, cured	17	4	4	1
Bacon, cured sliced	38	29	22	9
Salt pork, cured	10	7	31	21
White potatoes	38	32	32	20
Sweet potatoes	20	14	29	15
Mustard greens, fresh	7	0	14	12
Carrots, no tops	14	10	8	1
Green peppers	12	4	2	0
Lettuce, headed	31	24	12	2
Tomatoes, fresh	26	15	8	0
Celery, fresh	20	13	11	1
Onions, mature	35	27	34	19
Lemons	21	14	8	5
Apples	29	19	19	13
Bananas	29	17	22	5
Grapes, fresh	13	5	13	1
English peas, canned	17	14	10	2
Orange juice, canned frozen	15	4	6	0
Cola drink, bottled	27	15	17	9
Peanut butter	19	8	13	3
Catsup	22	15	8	0
Tomato sauce	4	6	14	0
Pickles	26	8	9	0

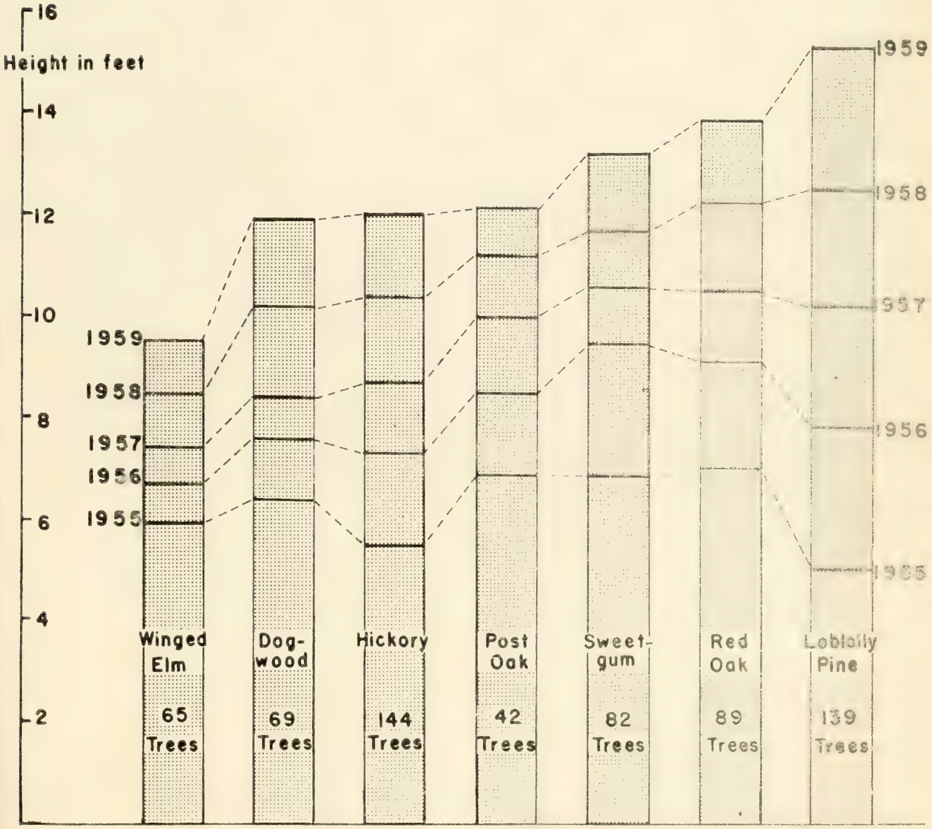
*Chi-square tests significant at 1% level, including some cases where an expected number was less than five.

Mississippi State University
Physical and Biological
Sciences Reference Room

BULLETIN 621 NOVEMBER 1960

A Progress Report on

The Ability Of Small Pines To Compete With Hardwood Sprouts



MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director

STATE COLLEGE MISSISSIPPI

JUL 10 1961

Conclusions

From this study the following conclusions are made:

1. Hardwood competition is the major cause for differential growth of planted seedling and sapling loblolly pines in erstwhile hardwood stands.

2. Results show the mean height of pines after three growing seasons in the field to be less than that of competing hardwood sprouts simply because of subjective selection of competitors.

3. This subjective selection of hardwood competitors on the basis of comparative height has been justified to an extent by the fact that pines have shown greater height growth persistence in the last four years than have hardwoods so that pines at a slight height disadvantage at three years in the field will have overcome that disadvantage, on the average, by the end of seven years in the field.

4. Taller pines are more persistent in height growth than shorter pines with the result that taller pines outstrip competitors to a greater extent than do shorter pines.

5. Since there are more hardwoods taller than short pines than there are taller than tall pines, this may explain why tall pines continue to grow more rapidly than do small ones. There is simply less tall competition.

6. A higher percentage of the total competition is close to short pines while, apparently, up to three seasons in the field, taller hardwoods are offering little competion to either tall or short pines if they are 5½ feet or farther away.

We may conclude then, that the planted pines which were shorter after three years in the field were so because of much close-in-competion. They have grown relatively slowly since then for the same reason. Had competition been reduced at that time to a situation comparable to that of the taller pines, they might have attained about the same height growth rate of the taller pines.

Figure 1. Showing rate of height growth of the average loblolly pine and of the average hardwood for the more common species competing with the pines.

A PROGRESS REPORT ON THE ABILITY OF SMALL PINES TO COMPETE WITH HARDWOOD SPROUTS

By E. G. ROBERTS

As a preface to this report it is well to point out that, with the progress being made in the foliar application of herbicides in pine-hardwood stands, stemwise treatment of hardwood competitors may not be necessary in the future. The study, nevertheless, illustrates a method of attacking the analysis of the competition to which a tree is subjected. The method of approaching the problem could be the same in, let us say, a mixed hardwood stand where we do not envision the use of a selective herbicide.

When planted pines are growing in competition with hardwood sprouts on what seems to be a reasonably uniform site and the pines and hardwoods are of seedling and sapling size, why do some pines thrive, in early years, and others die? If the pine planting stock is presumably uniform in seed source, seedling size, and the like, then four causes for differential growth and survival come to mind: (1) genetic differences, (2) differences in effectiveness of planting, (2) microsite differences, and (4) differing degrees of competition between pines and hardwoods.

In comparing the survival of pines and the uniformity of their growth in plantations on old fields devoid of woody plants with plantations where natural stands of hardwoods are being converted to pines, there seems to be much greater variation in survival and growth in these erstwhile hardwood areas. If this is true, the major factor influencing the success of the pines is the degree of competition with hardwood sprouts.

Pines exist in competitive situations. How can we measure such a situation and how can we evaluate the impact of the situation on a pine? Certainly some of the following elements enter into a competitive situation:

(1) size of pine, (2) size of hardwoods, (3) hardwood species, (4) distance to hardwoods, and (5) direction to hardwoods.

If we know the combination of situational elements which results in various pine survival and growth responses, we know how to alter situations to achieve our desired ends. Altering situations is another way of saying conducting cleanings. Cleanings are laborious at best; for this work it is desireable to get by with the least possible expenditure which will achieve the desired results.

The work described and discussed here was undertaken to provide information on pine response to competitive situations and then, by extension, to develop cleaning prescriptions.

The small pines and hardwood sprouts considered are on a branch of the Mississippi Agricultural Experiment Station near Pontotoc in north Mississippi. The site is on quite flat Flatwoods upland which is characterized by its impervious clay soil.

In the summer of 1952, all hardwoods 6 inches d. b. h. and larger were notch girdled, those from 3 inches to 6 inches d. b. h. were single-hack girdled, and those under 3 inches d. b. h. were felled with an axe or ditch-bank tool.

Loblolly pine seedlings were planted in late December 1952 and early January 1953. Spacing of pine seedlings probably more nearly approximated 5 by 5 ft. than it did the intended 6 by 6 ft. The area has received no treatment since planting. It has been free of fire and grazing.

An inspection of the plot at the end of the 1955 growing season showed profuse sprouting and every conceivable degree of competition between hardwoods and pines. It seemed likely that many pines would win out and that many others would not.

One hundred-fifty competitive situations were staked, numbered, measured,

Table 1. Stand prior to treatment in 1952.

D.b.h.	Sou. red oaks	Other[1] red oaks	Willow oak	Black jack oak	White oak	Post oak	Sweet-gum	Black-gum	Sh. pine	Red-cedar	Hick-ory	Other[2]	Plot total	Total per acre
Under 3' high	1719	1250	117	.....	39	1797	1562	3125	273	117	4414	8339	22752	4550.3
3' high to 1.5" d.b.h.	625	195	156	.....	39	780	430	859	39	39	1289	2812	7263	1452.6
2	35	30	29	.....	15	125	40	40	30	.....	115	85	535	107
3	35	15	5	.....	5	50	20	25	25	.....	30	55	265	53
4	30	5	20	.....	10	65	30	5	15	.....	70	40	290	58
5	8	7	5	1	2	27	18	11	7	.....	28	22	136	27.2
6	9	10	.....	1	3	26	9	6	4	.....	14	13	95	19
7	12	7	.....	.....	.....	23	9	4	4	.....	19	4	82	16.4
8	11	4	.....	.....	3	29	9	2	4	.....	19	3	84	16.8
9	8	5	1	.....	.....	9	9	2	1	.....	17	4	56	11.2
10	6	4	1	.....	1	18	2	1	1	.....	8	1	43	8.6
11	9	5	1	.....	1	13	1	1	1	.....	2	1	35	7
12	6	1	.....	.....	1	7	6	.....	.....	.....	.....	2	23	4.6
13	1	4	.....	.....	.....	5	.....	.....	.....	.....	.....	.....	10	2
14	2	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	2	0.4
15	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	0.2
16	.....	.....	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	1	0.2
17	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	.....	1	0.2
18	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	1	.....	2	0.4
19	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	0.2
20	.....	1	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1	0.2
24	.....	.....	.....	.....	.....	1	.....	.....	.....	.....	.....	.....	1	0.2
Plot total	2518	1543	326	2	120	2975	2145	4082	404	156	6027	11391	31679	
Total per acre	503.6	308.6	65.2	0.4	24	595	429	816.4	80.8	31.2	1205.4	2278.1		6335.8

[1] Largely cherrybark oak. [2] Winged elm most common; also persimmon and dogwood were abundant.

and recorded. These situations covered a range of competition in regard to the pine in question from apparently hopeless conditions to ones where the pine was definitely in the clear.

For each situation, the following were recorded: (1) height of the pine, (2) direction and (3) distance to its competitors, (4) species, (5) stump diameter of the hardwoods cut, (6) number of sprouts per clump and (7) height of competitors (of the tallest member, in the case of sprout clumps). For the most part, trees shorter than the pine in question and those over six feet away were considered to be offering it little competition.

At the end of the 1955 growing season, few hardwoods over six feet away from the pines in question seemed to be in competition with them. Since competitive conditions have changed with time, in the 1959-60 winter an enlarged situation was measured and recorded where it seemed necessary in order to carry the study on for a few more years.

The seven conditions recorded at each competitive situation may all affect the survival and growth of the pines in question — as, indeed, may many conditions not considered. Brief mention should be made of those conditions which are not included in the material which follows. **Direction** from the pine in question to a possible competitor may affect the pine but it is not apparent from a cursory analysis of the data. Between the time of cutting in the summer of 1952 and the time this study was installed at the end of the 1955 growing season, so many of the little stumps had rotted and disappeared that **stump diameter** as a factor in determining sprout size yielded no useful information. **Number of sprouts per clump** may have a considerable effect on some competitive situations, but consideration of numbers per clump increases the complexity of the problem out of all reason.

Attention is directed now to the growth rates and patterns of various elements of the competitive situations. In Table 2, the unequal number of trees taken by species in the shortest and tallest groupings results in nearly equal percent-

Table 2. Growth patterns of planted loblolly pines and of hardwood sprouts.

	Mean ht. in ft. at end of 3 yrs.	Mean annual ht. growth in ft. during 1st 3 yrs.	Mean ht. in ft. end of 7 yrs.	Mean annual ht. growth in ft. during last 4 yrs.	Growth persistence in % $\frac{\text{Col. 4}}{\text{Col. 2}}$ X 100
	(1)	(2)	(3)	(4)	(5)
20 shortest[1] loblolly pines	2.9	0.98	8.3	1.34	137.85
All (139) loblolly pines	5.0	1.68	15.3	2.56	152.41
20 tallest loblolly pines	7.2	2.39	20.7	3.38	141.35
12 shortest sweetgums	4.6	1.54	7.5	0.73	47.30
All (82) sweetgums	6.9	2.30	13.2	1.57	68.37
11 tallest sweetgums	12.9	4.29	20.3	1.85	43.20
11 shortest red oaks	3.7	1.24	8.0	1.06	85.06
All (89) red oaks	7.0	2.33	13.8	1.71	73.67
12 tallest red oaks	11.3	3.76	20.3	2.24	59.50
20 shortest hickories	3.2	1.08	7.8	1.14	105.58
All (144) hickories	5.5	1.83	12.0	1.62	88.73
19 tallest hickories	8.2	2.72	16.4	2.07	75.96
65 winged elms	5.9	1.97	9.5	0.88	44.71
69 dogwoods	6.4	2.14	11.9	1.38	64.48
42 post oaks	6.9	2.31	12.1	1.29	55.57
20 ashes	6.4	2.13	11.1	1.17	55.01
19 blackgums	5.6	1.88	9.7	1.01	53.97
23 red maples	6.9	2.31	13.5	1.25	54.07
17 white oaks	7.1	2.35	14.0	1.74	74.08

[1] In each case of shortest and tallest groupings, reference is to heights in 1955.

ages of the total number of trees in each species; they range from 12.4% to 14.4%. In the case of the shortest and tallest pines, the data are for the 20 shortest and 20 tallest in 1955 for which the competitive situation has not changed through death or deformation of competing hardwoods.

The data in Column 1 of Table 2 show that the mean height of loblolly pines was less in 1955 than the mean heights of all species of hardwoods reported. One cannot conclude from these data that during the first three years hardwoods grow more rapidly than pines. Many small hardwoods were not recorded as being competitive because they were considerably smaller than the pines. Column 5, Growth Persistence, shows whether the annual growth rate is accelerating or declining. The data indicate that the average planted pines which are at a slight height disadvantage in relation to hardwood sprouts after three years in the field will overcome that disadvantage by the seventh year in the field. The data confirm what might be expected: taller trees continue to grow more rapidly in height than do shorter trees. Growth in height is more persistent for loblolly pines than it is for hardwood sprouts. For the three most abundant hardwoods, ranking in persistence of height growth is from most to least persistent hickory, red oak, sweetgum. (see Table 3). The growth patterns for the more abundant species are depicted in Figure 1.

Table 3. Ranking of all pines and hardwood from most to least in amount and persistence of height growth.

Mean annual ht. growth during last 4 years	Growth persistence
Loblolly pine	Loblolly pine
White oak*	Hickory
Red oak	White oak*
Hickory	Red oak
Sweetgum	Sweetgum
Dogwood	Dogwood
Post oak	Post oak
Red maple*	Ash*
Ash*	Red maple*
Blackgum*	Blackgum*
Winged elm	Winged elm

*Small samples—17 to 23 trees.

Table 4 presents the expected fact that there are more hardwoods which are taller than short pines than there are those taller than tall pines while Table 2 shows that, presumably as a result of this condition, the tall pines continue to grow more rapidly than the short pines. Table 4 shows, further, that of the total competition as defined, about the pines a higher percentage is closer to short pines than is the case with tall pines (columns 5 and 9).

Column 10 in Table 4 shows that the number of hardwood competitors at a certain distance from the tall pines is a small percentage of the number at the same distance from the short pines up to distances 5 feet from the pines. This is reasonable and to be expected. At 5½ feet an unreasonable situation prevails—there are more taller hardwoods (more competition) about the tall pines than about the short ones. At 6 feet competition is equal. Since this is contrary to reason, we may fairly conclude that taller hardwoods at 5½ feet and more distance do not offer pines much competition under these conditions. This conclusion is strengthened by the observation that in column 9 over 50% of the competition, as defined, is within 5 feet of the pines and in column 5 within 3 feet.

Column 11 may be interpreted as follows: at 2 feet and closer, there is only 3.57% as much hardwood competition taller than the tallest pines as there is hardwood competition taller than the shortest pines; at 2½ feet and closer, there is 6.15% as much; at 3 feet and closer, 7.14%; etc. Column 11 fortifies the conclusion that, with the shortest pines, there is a higher percentage of the total competion close in to the pine.

A table was developed similar to Table

4 for all trees at least one foot taller than the pines, another for all at least one and one-half feet taller, etc. As these compilations add little to the picture, they are not presented here.

Table 5 shows what could already be deduced — that the pines which were larger after three growing seasons in the field have outstripped competitors at the end of seven growing seasons to a far greater extent than have the less favored pines.

Recommendations

On the basis of the data presented here, the following recommendations are made for cleaning planted loblolly pines at ages of about three to eight years in the field.

(1) No hardwood taller than the pine should be left within two feet of the pine.

(2) Not more than two hardwoods taller than the pine should be left within five feet of the pine.

(3) No hardwood more than three feet taller than the pine should be left within five feet of the pine.

Table 4. Trees which were taller than the pines at the end of the 1955 growing season and which are at the indicated distance from the pines.

For the 20 pines shortest in 1955[1]					For the 20 pines tallest in 1955[1]					
Dist. from pine	No. for all pines	No. per pine	Accum. no. per pine	Accum. % of total	No. for all pines	No. per pine	Accum. no. per pine	Accum. % of total	$\frac{(7)}{(3)} \times 100$	$\frac{(8)}{(4)} \times 10$
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	5	0.25	0.25	3.10	----	------	-- ---	------	------	------
1	15	0.75	1.00	12.42	----	------	-- --	------	--- --	------
1½	10	0.50	1.50	18.63	----	----	-- --	- ----	----	------
2	26	1.30	2.80	34.78	2	0.10	0.10	5.56	7.69	3.57
2½	9	0.45	3.25	40.37	2	0.10	0.20	11.11	22.22	6.15
3	19	0.95	4.20	52.17	2	0.10	0.30	16.67	10.53	7.14
3½	14	0.70	4.90	60.09	3	0.15	0.45	25.00	21.43	9.18
4	26	1.30	6.20	77.02	4	0.20	0.65	36.11	15.38	10.48
4½	12	0.60	6.80	84.47	4	0.20	0.85	47.22	33.33	12.50
5	13	0.65	7.45	92.55	2	0.10	0.95	52.78	15.38	12.75
5½	1	0.05	7.50	93.17	8	0.40	1.35	75.00	800.00	18.00
6	8	0.40	7.90	98.14	8	0.40	1.75	97.22	100.00	22.15
6	3	0.15	8.05	100.00	1	0.05	1.80	100.00	33.33	22.36
Total	161	8.05	--- --	------	36	1.80	-- - -	------	-- --	---- -

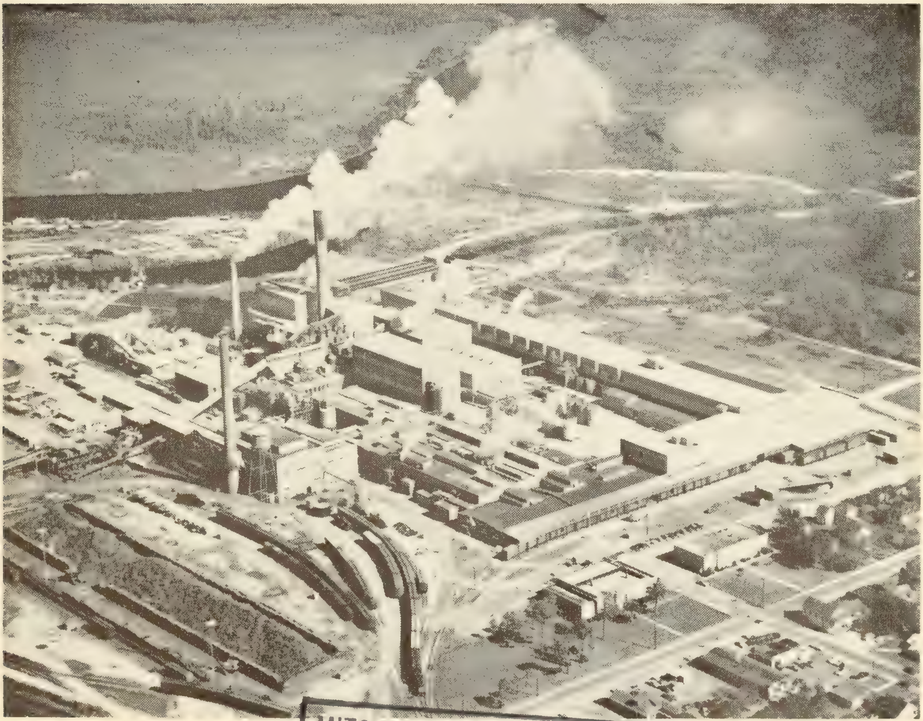
[1] Basis for selection: These are the shortest (or tallest) in 1955 of those in situations where the situation has not been altered through death of competitors or through a change in a competitor through being broken or pinned down by falling, girdled hardwoods. Where some but not all of a 1955 pine height class (one-half foot height classes) had to be taken to get 20 situations, the situations were arranged in numerical order and taken in that order.

Table 5. Change in numbers of competitors with time.

Ht. of pines in 1955	No. of pines	No. of Hardwoods per pine taller than pine	No. pine living in 1959	No. of hardwoods per pine taller than pine in 1959
1½	2	12.0	1	8.0
2	10	6.3	7	5.0
2½	2	6.5	2	6.5
3	11	8.2	11	6.7
3½	8	7.2	7	5.7
4	13	5.7	13	2.7
4½	18	6.6	17	2.9
5	22	4.8	22	1.6
5½	17	4.1	17	1.2
6	16	2.6	15	0.6
6½	10	2.1	10	0.4
7	15	1.9	14	0.4
7½	0	0	0	0
8	2	0.5	2	0
8½	1	3.0	1	0
9	3	1.7	3	0
Total or average	150	4.9	142	2.8

BULLETIN 622 JUNE, 1961

Jackson County Soils



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HENRY H. LEVECK, Director

STATE COLLEGE MISSISSIPPI

This bulletin is published to help farmers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, buildings, ponds, and other structures; aid foresters in managing woodlands; add to the soil scientist's fund of knowledge and aid teachers of science in public schools.

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SURVEY PARTY FOR JACKSON COUNTY

Soil survey made by J. H. Dent and W. A. Cole, Party Chiefs, M. E. Shaffer, L. H. Watts, V. C. Allgood, Soil Conservation Service; R. E. Fulgham, Mississippi Agricultural Experiment Station; and Y. H. Havens, Soil Conservation Service Soil Correlator.

The Mississippi Agricultural Experiment Station cooperated with the Soil Conservation Service to carry out the soil survey of Jackson County.

ON COVER:

This International Paper Mill at Moss Point is one of the major sources of income for farmers of Jackson County. The mill buys a great portion of the county's forest products and employs many people.

Jackson County Soils

By Robert E. Fulgham and H. B. Vanderford

This bulletin describes the soils of Jackson County in detail. It is intended for use with a special soil map of any farm or area of land which may be obtained from the Soil Conservation Service or the County Agent's office in Pascagoula, Mississippi.

This soil survey was conducted as a cooperative effort of the Mississippi Agricultural Experiment Station, the Soil Conservation Service and the taxpayers of Jackson County. The Experiment Station and other agencies involved deeply appreciate the financial support of the Board of Supervisors and the splendid personal cooperation of the citizens of Jackson County.

In order to prepare this bulletin and the map, a county-wide soil survey was made. Soil surveyors with the Mississippi Agricultural Experiment Station and the Soil Conservation Service, working together, studied almost every acre of land in the county. This was done to classify the soils and to find out which are best suited for the various crops, pastures, forests, and other uses.

The soils of Jackson County are not so uniform that every spot in an area mapped as one particular type of soil will be identical. Due to past management and past land use, all of the same soil types will not produce the same crop yields. It must be understood that the different soil types or mapping units will have some range in properties within each soil type.

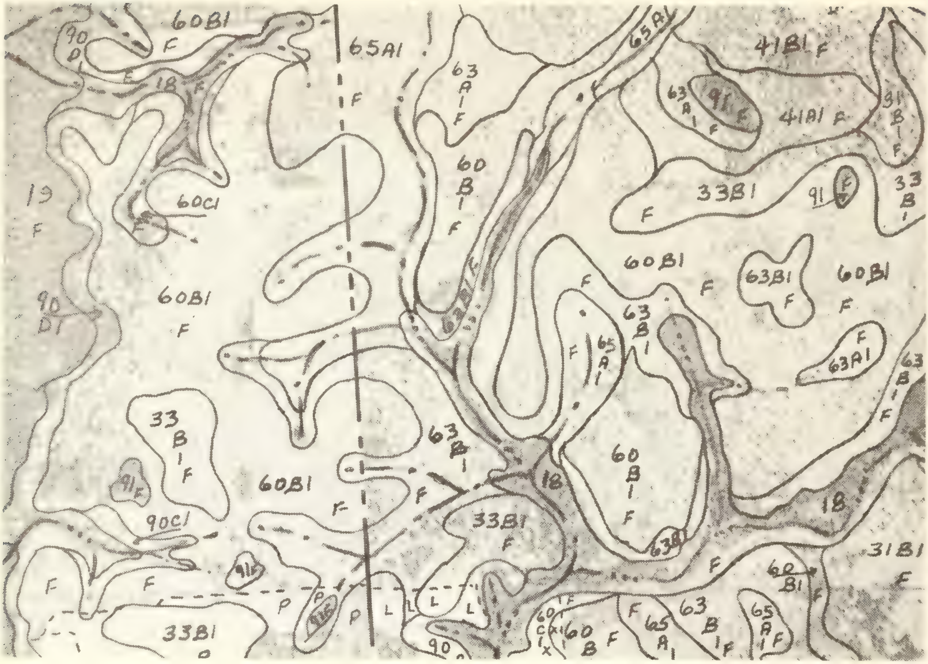
Soils must be examined to a depth of 36 inches or more for proper classification. Often two soils will have identical surface layers, but will differ greatly in the subsoil and therefore have different land uses. The subsoil regulates such important things as water-holding capacity, depth and extent of root growth, leaching of fertilizer and soil temperature which greatly affect plant growth. A cross-sectional view of a soil, including its surface, subsoil and parent material is called a soil profile. For the reasons given above a study of the entire soil profile is very important.

Jackson County is in the extreme southeastern corner of Mississippi. On the north it is bordered by George County, on the west by Harrison County, on the south by the Gulf of Mexico and on the east by Mobile County, Alabama. It is approximately 28 miles square and comprises an area of 744 square miles, or 476,160 acres.

The area now occupied by Jackson County was included among the lands which Spain and France attempted to acquire along the south coast of the new continent. A few descendants of the Latin races live in the county today. The Old Spanish Trail, a few buildings, and the Old Spanish Fort at Pascagoula remain as about the only historical evidence of these settlements in Jackson County. Old United States Highway 90 approximately follows the route of the Old Spanish Trail.

Timber, the greatest natural resource of the county, attracted people of various nationalities, who came to work in the lumber and turpentine industries rather than to acquire land. English, Italian, Russians, and some Germans and Swedes migrated to this region soon after the United States acquired possession and spread out into broadly scattered settlements over the county.

Lumber and forest products have always been important to the growth



Typical area of Jackson County soil map.

of Jackson County. After the Civil War timber was the principal source of income. In the report on the soil survey of the Scranton area made in 1909, it is stated that about 25 lumber mills were in operation at that time. Presently there are two saw-mills with a number of small mills running part-time. With the establishment of the International Paper Mill at Moss Point in 1912, the timber industry has changed from logs to pulp-wood.

During World War II, Ingall's Shipbuilding Corporation was established at Pascagoula, Mississippi. With the prospect of higher wages, many farmers have turned to industry and have planted their land in pine seedlings or let it reproduce naturally. Potentially, Jackson County is one of the most productive counties in the state. It has large, level, sandy fields, with a good water supply only a few feet below surface. When the need arises, these fields can be cleared and, with supplemental irrigation, be made to produce high yields of food crops.

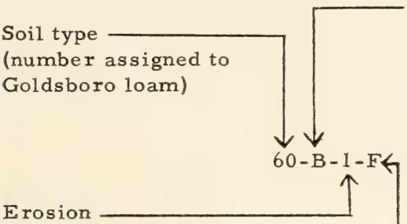
Symbols and Numbers on Soil Map

The first step in using your soil map is to examine it carefully and become familiar with the symbols used to designate certain features found on the land.

Every separate area of soil is identified on the map by a code number. The first number tells the soil type, the letter indicates the percent of slope and the second number is the amount of erosion that has taken place. The combination of the two numbers and the letter is called a mapping unit.

COMPOSITE SOIL SYMBOL

Soil type number - Slope Class - Erosion Class - Present Land Use



Soil type (number assigned to Goldsboro loam)

60-B-1-F

Erosion

Slope

A. 0 to 2 percent nearly level
B. 2 to 5 percent gently sloping
C. 5 to 8 percent moderately sloping
D. 8 to 12 percent strongly sloping
E. 12 to 17 percent steeply sloping
F. 17 percent plus very steeply sloping

Erosion

1. None to slight (less than 25 percent of original surface has been lost)
2. Moderate (25 to 75 percent of the original surface has been lost)
3. Severe (more than 75 percent of the original surface and part or all of the B horizon has been lost from the area)

Present Land Use

L. Cultivated Land
L_1. Orchards
F. Wooded Land
X. Idle Land
P. Permanent grassland
H. Urban Areas Homesites, etc.

For example, 60B1 is analyzed as follows:

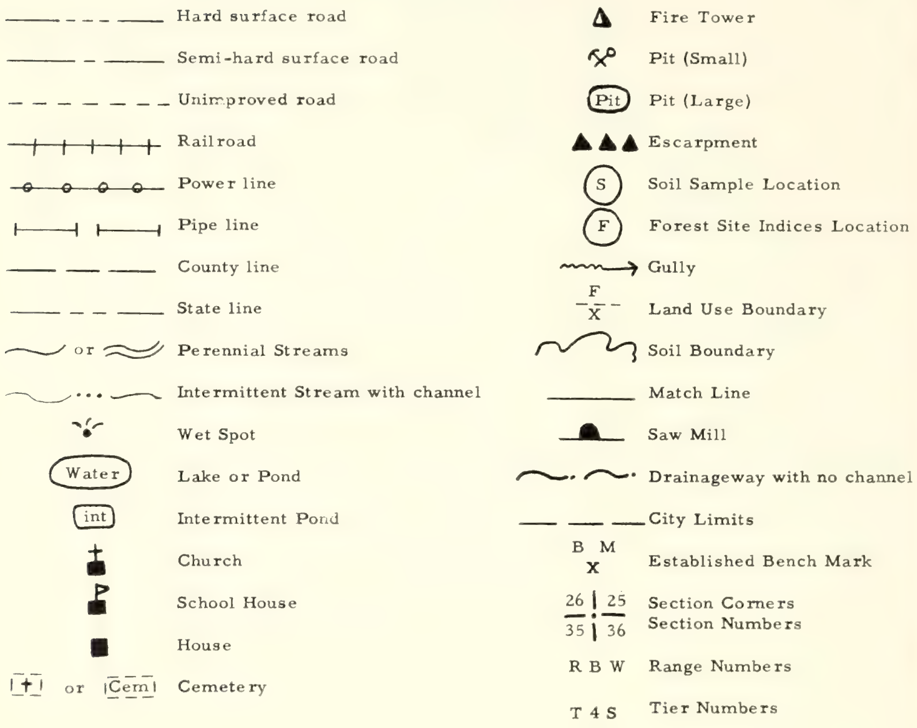
60—The soil is a moderately well-drained Goldsboro loam.
B—The soil is a gently sloping soil with a 2 to 5 percent slope.
1—The soil is a slightly eroded phase (0 to 25 percent of the original surface may have been lost by erosion).

Land Capability Classes for Jackson County

Several different colors may appear on your map. Each color tells you about the land: whether it is suited for cultivation or not, and the general degree of difficulty or risk involved in its safe use without damage. Each color shows one of eight classes of land that are called land capability classes. The table on land use and management shows the class and color found on the map, and also the subclass, soil type and phase found in each class. The classes are distinguished by Roman numerals as well as by the standard colors.

Classes I and II include the land that is suited for regular cultivation, and Class III can be cultivated if certain limitations are observed. The major hazard is water erosion which can be controlled by use of contours. Classes IV, V, VI, VII are not generally suited for cultivation but may

Mapping Symbols


Hard surface road
Semi-hard surface road
Unimproved road
Railroad
Power line
Pipe line
County line
State line
or
Perennial Streams
Intermittent Stream with channel
Wet Spot
Water
Lake or Pond
int
Intermittent Pond
Church
School House
House
Cem
or
Cemetery
Fire Tower
Pit (Small)
Pit
Pit (Large)
Escarpment
S
Soil Sample Location
F
Forest Site Indices Location
Gully
F
X
Land Use Boundary
Soil Boundary
Match Line
Saw Mill
Drainageway with no channel
City Limits
B M
X
Established Bench Mark
26 25
35 36
Section Corners
Section Numbers
R B W
Range Numbers
T 4 S
Tier Numbers

be used for grazing or forestry. Class VIII land can only be used for wildlife or recreation.

Physical features of the land that make it risky determines the land capability class. On the map these physical features are denoted by three different symbols; "e" erosion, "w" water and "s" soil. Some land is subject to erosion if not properly protected. Other land is naturally wet, so that drains must be installed to lower the water table or remove surface water so crops can be grown. Still other land is shallow or may be very sandy causing other special conditions to arise. These three kinds of limitations make up three possible subclasses of land within each of the land capability classes.

Within Class III land, for example, all three of the land-capability subclasses occur. All Class III land is rather severely limited in its use, although it is suited for cultivation. Often all three of the subclasses—wet soils, sloping land and land with special soil textures may appear on a single farm. They are suited to different crops and should be managed in different ways. The land-capability map shows these subclasses. Table 1 lists the capability class, subclass, soil type and phase. Here are the descriptions of the seven land capability classes that appear in Jackson County:

Class I is very good land that can be cultivated safely with ordinary farming practices. Row crops can be grown intensely, provided legumes for soil building are used and fertilization is adequate.

Class II land is good, but has some limitations. Row crops should be grown on it about one-half time, with a soil builder being grown the remainder of the time. Fertilization will be needed and some conservation practices may be needed. Some of this class will need erosion control measures while other parts will need drainage of various types. Some will need surface drainage, but other areas will need subsurface drainage.

Class III land is moderately good land for cultivation. This land can be used for row crops about one-third of the time provided certain protective measures are observed. Fertilization will be needed with cover crops being grown at least two-thirds of the time. Some land will need erosion control measures while other parts will need drainage both surface and subsurface. There will be a need for supplemental irrigation on some of this class.

Class IV land is best suited to permanent hay, pasture, or forests, but on which row crops can be grown

Table 1. Classes of land and acreage in Jackson County

Class	Color On Map	Sub-Class	Acres	Soil No.	Soil Type and Phase
I	Green	I_1	3,834	31	Ruston and Orangeburg fine sandy loams, A1
			488	32	Orangeburg sandy loam, A1
			3,382	33	Norfolk fine sandy loam, A1
II	Yellow	IIe	12,627	31	Ruston and Orangeburg sandy loams, B1
			19,160	33	Norfolk fine sandy loam, B1
			627	41	Savannah loam, B1
			7,973	43	Bowie loam, B1
			34,858	60	Goldsboro loam, B1
			1,332	62	Fairhope very fine sandy loam, B1
		IIs	3,262	43	Bowie loam, A1
			551	41	Savannah loam, A1
			3,008	57	Lakeland loamy sand, A1, B1
			12,399	58	Eustis loamy sand, A1, B1
		IIw	17,368	60	Goldsboro loam, A1
III	Red	IIIe	3,786	31	Ruston and Orangeburg fine sandy loams, C1
			5,261	33	Norfolk fine sandy loam, C1
			4,795	43	Bowie loam, C1
			6,187	60	Goldsboro loam, C1
			568	62	Fairhope very fine sandy loam, C1
			5,926	82	Susquehanna, Bowie and Boswell soils, B1
		IIIs	4,391	44	Pheba loam, A1, B1
			1,057	57	Lakeland loamy sand, C1
			1,713	58	Eustis loamy sand, C1
			18,409	75	Klej loamy sand
		IIIw	29,850	63	Lynchburg very fine sandy loam, A1, B1
			8,334	64	Dunbar loam, A1, B1
IV	Blue	IVe	1,380	33	Norfolk fine sandy loam, D1
			1,809	31	Ruston and Orangeburg fine sandy loam, D1
			862	43	Bowie loam, D1
		IVs	5,772	75	Klej loamy sand, C1, D1
			357	59	Eustis and Lakeland sands, D1
V	Green	Vs	5,844	68	Coxville silt loam, A1, B1
			974	91	Grady soils
		Vw	47,346	19	Alluvial land
			54,751	65 (77)	Rains loam dark surface phase, A1, B1
			9,896	76 (67)	Bayboro silt loam
			1,904	74	Plummer loamy sands, dark surface phase
			7,247	78	Scranton loamy sands, A1, B1
			14,432	79	Plummer loamy sands
VI	Orange	VIe	476	31	Ruston and Orangeburg fine sandy loams, E1
			11,194	82	Susquehanna-Bowie-Boswell soils, C1, D1
			13,224	90	Sloping and Steep sandy and clayey land, C1, D1, E1
		VIs	324	57	Lakeland loamy sands, D1, E1
			815	58	Eustis loamy sands, D1, E1
			2,833	59	Eustis and Lakeland sands, A1, B1, C1, D1, E1
VII	Brown	VIIw	53,360	18	Swamp
VIII	Purple	VIIIs	2,861	100	Coastal Beach
			1,819	101	Dyne sand
			24,117	99	Tidal Marsh
Miscellaneous			1,500		Made Land

to a very limited extent with soil building and soil conserving crops being grown at least three-fourths of the time. This land will need terraces, contour cultivation, and gully control. It will require liberal and frequent fertilization and some supplemental irrigation at times.

Class V land is suitable for the production of hay, grazing or forest without any particular conservation measures. During dry years some of this land can be used for truck crops provided drainage is applied to remove both surface and subsurface water.

Class VI land can be used for permanent pasture or forest. Care should be exercised to get a good vegetative cover established and it should be maintained at all times.

Class VII land is best suited for grazing or forestry with some severe limitations. The soils in this class are moderately well to poorly drained and are subjected to flooding.

Class VIII land is suitable for wildlife or recreational purposes. Any vegetative cover should be maintained and protected.

Forestry and Its Place in Jackson County

One of the most valuable crops grown in this part of the Coastal Plain region is the pine tree. Long leaf and slash grow rapidly on practically every soil in the county except the very wet swamp land and the brackish marsh. The trees make a remarkable growth on all the Norfolk, Goldsboro, Lynchburg, Ruston, Scranton and Rains; also, they do well on the Susquehanna and Plummer soils. Any failure to consider pine forestry overlooks an opportunity for profitable utilization of the land.

Jackson County's fabulous timber resource offered early settlers opportunity for employment in logging and sawmilling operations. The vast timber wealth also accounted for the growth of certain towns and, in part, for the development of the seaport and railroad facilities; of the 476,160 acres in Jackson County, trees or forest lands account for over 375,000 acres.

On the Eustis, Lakeland and some of the Susquehanna soils grow scrub oaks known as blackjack and turkey oak. Ruston, Norfolk, and Goldsboro soils produce pine with live oak, blackjack, magnolia, and dogwood. On the Plummer, Rains, and Bayboro we find sweet bay, black gum, sweetgum, cypress, and slash pine growing quite well. In the stream bottoms grow the wateroak, willow oak, hickory, sweetgum, tupelo gum, black gum, yellow poplar, ash, cypress, sweet bay, magnolia and several other species. Table 5 gives the expected height of pine trees at maturity.

If the farmers of Jackson County would realize what a substantial return they would get from pine timber, then they would try to protect it. Each spring they let fire and a few head of range-fed cattle destroy countless numbers of pine trees, which, if protected, give promise of ultimately returning more profit than cultivated crops and livestock.

Table 2 includes data on sawtimber and pulpwood cut during the period of 1945 through 1959 and the tax paid on these products:

Table 2. Sawtimber and pulpwood cut in Jackson County.[1]

Year	Sawtimber (Board Feet)	Pulpwood (Cords)	Tax Paid
1945	25,382,000	36,193	$ 4,453.42
1946	17,517,000	40,822	4,692.60
1947	27,870,000	38,782	7,016.34
1948	27,433,000	67,528	8,806.32
1949	17,231,000	50,948	6,861.13
1950	21,288,000	51,794	8,861.98
1951	21,406,000	35,110	8,478.70
1952	22,667,000	41,132	10,109.69
1953	9,371,000	36,031	6,745.29
1954	13,156,000	41,347	6,377.73
1955	13,800,000	41,950	6,916.96
1956	16,007,000	40,881	11,857.47
1957	9,538,000	41,653	11,357.21
1958	8,065,000	35,545	8,976.69
1959	10,752,000	44,853	10,366.13

[1] Source: Mississippi State Tax Commission

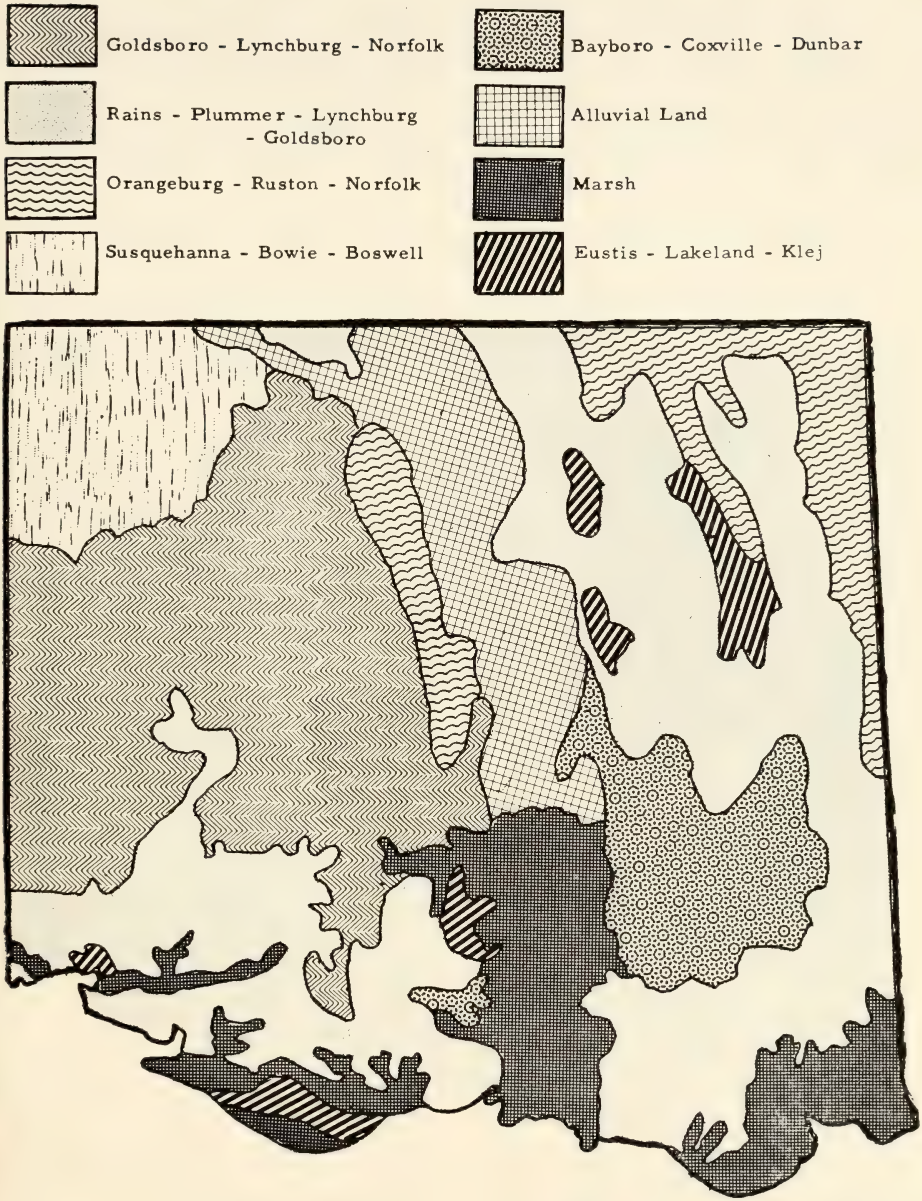

Goldsboro - Lynchburg - Norfolk
Bayboro - Coxville - Dunbar
Rains - Plummer - Lynchburg - Goldsboro
Alluvial Land
Orangeburg - Ruston - Norfolk
Marsh
Susquehanna - Bowie - Boswell
Eustis - Lakeland - Klej

Table 3. Guide for use in determining relative suitability of crops for soils.

Coastal Flatwoods
Resource Area

Key to Chart 1 — Suited 2 — Poorly suited 3 — Not suited	**Bayboro**	**Bowie**	**Coxville**	**Dunbar**	**Eustis**	**Fairhope**	**Goldsboro**	**Grady**	**Klej**	**Lakeland**	**Lynchburg**	**Norfolk**	**Orangeburg**	**Pheba**	**Plummer**	**Rains**	**Ruston**	**Scranton**	**Savannah**
Row Crops																			
Cotton	3	1	2	2	1	1	1	3	1	1	2	1	1	2	3	3	1	2	1
Corn	3	1	3	2	1	2	1	3	1	1	2	1	1	2	3	3	1	2	1
Soybeans	2	1	1	1	1	1	1	3	1	1	1	1	1	2	2	2	1	2	1
Gr. sorghum	2	1	2	1	1	1	1	3	1	1	1	1	1	2	2	2	1	2	1
Small Grain																			
Oats	3	1	2	2	1	1	1	3	1	1	2	1	1	2	3	3	1	2	1
Wheat	2	1	2	2	1	1	1	3	1	1	2	1	1	2	3	2	1	2	1
Barley	2	1	2	2	1	1	1	3	1	1	3	1	1	3	3	2	1	2	1
Rye	2	1	2	2	1	1	1	3	1	1	2	1	1	2	2	2	1	2	1
Rice	1	3	1	1	3	3	3	3	3	3	2	3	3	2	3	1	3	2	3
Ryegrass	2	1	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2	1
Grasses																			
C. bermuda	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2	1
Bermuda	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	1	1	2	1
Fescue	2	1	1	1	3	1	2	2	2	3	1	2	2	1	2	2	2	1	1
Dallis	2	2	2	2	3	2	2	3	3	3	2	2	2	2	2	2	2	2	2
Johnson	3	1	3	2	1	1	1	3	1	1	2	1	1	2	3	3	1	3	1
Bahia	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1
Sudan	3	1	3	2	1	1	1	3	1	1	2	1	1	2	3	3	1	2	1
Millet	3	1	2	2	1	1	1	3	1	1	2	1	1	2	3	3	1	2	1
Rescue	3	1	2	1	1	1	1	3	1	1	1	1	1	2	2	2	1	2	1
Legumes																			
Wild w. peas	1	1	2	1	2	1	1	2	2	2	1	1	1	1	1	1	1	2	1
Vetch	2	1	2	1	2	1	1	3	1	2	1	1	1	1	2	2	1	1	1
Alfalfa	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
Peas, field	2	1	1	1	1	1	1	3	3	2	3	2	2	3	3	3	2	3	1
Les. sericea	3	2	3	3	2	3	2	3	2	2	3	2	2	3	3	3	2	3	2
An. lespedeza	1	1	1	1	1	1	1	3	1	1	1	1	1	1	2	1	1	1	1
Red clover	3	2	3	3	2	2	2	3	2	2	3	2	2	3	3	3	2	2	2
Wh. clover	1	1	1	1	2	1	1	1	1	2	1	2	2	1	1	1	2	1	1
Cr. clover	3	1	3	3	1	2	1	3	1	1	2	1	1	2	3	3	1	3	1
Lad. clover	2	2	2	1	2	2	2	2	1	2	1	1	1	1	2	2	1	2	2
Sweet clover	3	2	3	3	2	2	2	3	2	2	3	1	1	3	3	3	1	3	2
Orchard																			
Apples	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
Peaches	–	–	–	–	1	–	1	–	1	–	–	1	1	–	–	–	1	–	–
Pecans	3	1	2	2	1	1	1	3	1	1	2	1	1	2	3	3	1	3	1
Pears	3	1	2	2	1	1	1	3	1	1	1	1	1	2	3	3	1	3	1

SCS
MISSISSIPPI
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Source: Prepared in cooperation with
Mississippi Agricultural Experiment Station

Woodland Forage and Range Grazing

A stock law, enacted in 1958, has caused a decrease in the number of range cattle in Jackson county. This trend will continue until fences are established and the unrestricted movement of cattle has stopped. Then, woodland and salt marsh grazing will increase again. Improvement management, woodland forage and salt marsh range could increase the annual income of Jackson County by $390,000.

The salt marsh range could support some cattle. Due to high salinity and danger of flash flooding, these lands are not suitable for cultivation or tree growth. Grazing and wildlife are the only significant uses of this land known at present.

Grazing is a secondary use to the production of timber in woodland. Of the 375,000 acres of woodland in the county, 25,000 acres are hardwood. Grazing so seriously damages hardwood timber that it is not recommended for use in a range grazing program. Of the 350,000 acres of pine timber, one-half is so located that it can be grazed. This area could ultimately support about 5,800 cattle. With proper management, pine tree lands can be grazed without appreciable damage. Grazing can greatly reduce fire hazards by removing slightly less than 50 percent of the forage. This will tend to encourage the spread and increase of desirable forage plants. With the increase of desirable plants more cattle could graze the ranges.

Engineering Uses

Soil surveys are being used increasingly in engineering work, especially in highway planning and construction, and in urban development areas. The basic facts about soils needed to predict their behavior in agricultural fields include most of those needed to predict their behavior as subgrades or foundation materials. The several soil properties have different relevancies for the two interpretations—agricultural and engineering—but the basic classification serves for both.

Soil maps are helpful in planning locations for structures and for predicting the problems of construction to be dealt with. They are useful in locating such materials as sand, clay and suitable "topsoil" for dressing road banks and graded yards. In home construction soil maps can be used to locate septic tank drainage fields so they will function properly. Table 4 gives the rating of each soil for its drainage possibility. Also, the map will show the areas that will not allow a drainage field to operate. A person would want to investigate these areas more thoroughly before he builds his home.

Table 4 gives some of the engineering ratings of the soils found in Jackson County.

Soil Series in Jackson County

Bayboro Series: This series includes poorly drained, shallow soils in the Flatwoods Area of the Coastal Plains. These soils have been formed from thick beds of acid clays. They have a black silt loam surface with a dark gray mottled firm sandy clay loam subsoil. During prolonged wet seasons, Bayboro soils are covered with water because the series occurs only on level or nearly level areas. The high water table prevents the downward movement of water through the solum. The Bayboro soils are inherently low in fertility, very strongly acid, and have a low available moisture capacity. With proper drainage this series can become very productive.

Bowie Series: This series is composed of medium-textured, moderately well to well-drained upland soils. They were developed from acid loams and sandy loams of the lower Coastal Plain. They have a brownish-yellow loam to very fine sandy loam surface with a friable subsoil that is a strong brown loam in the upper part, but is splotched with red in the lower part. Bowie soils in this area usually contain few to many iron concretions throughout the soil profile. They are associated with Savannah and Goldsboro soils. The Bowie soils are inherently low in fertility, but moderate in available moisture capacity and very strongly acid. They are very responsive to good management, and are, therefore, important to agriculture in this county.

Boswell Series: These soils are developed over acid clayey sediments with subsoils of firm clay that is red in the upper part and strongly mottled below. The Boswell series is associated with the Bowie and Susquehanna soils. The surface is a yellowish brown fine sandy loam; whereas, the subsoil is a mottled yellowish-red firm clay. Boswell soils are inherently low in fertility and very strongly acid. This series generally has a shallow topsoil causing the rate of runoff to

Table 4. Engineering Ratings of Jackson County Soils.

Soil Type	Permeability[1]	Shrink-Swell Potential[2]	Structure Foundation Material	Septic Tank Location	Remarks
Bayboro	Slow	Moderate	Fair to Poor	Poor	High Water Table
Bowie	Moderate to Slow	Moderate to low	Fair to Good	Fair to Poor	Clayey Subsoil
Beach	Rapid	None	Good	Good	Normally not used for house sites
Coxville	Slow	Moderate	Fair to Poor	Poor	Clayey Soil
Dunbar	Moderate to Slow	Moderate to low	Fair to Poor	Poor	Clayey Subsoil
Eustis	Rapid	None	Good	Good	
Fairhope	Slow	Moderate	Fair to Poor	Poor	Clayey Soil
Goldsboro	Moderate	Low	Fair to Good	Good	
Grady	Slow	Moderate	Poor	Poor	High water table—Clayey subsoil
Klej	Rapid	None	Good	Good	
Lakeland	Rapid	None	Good	Good	
Lynchburg	Moderate	Low	Fair to Good	Fair	High water table
Norfolk	Moderate	Low	Good	Good	
Orangeburg	Moderate	Low	Good	Good	
Pheba	Moderate to Slow	Low	Fair to Good	Poor	High water table—Fragipan
Plummer	Rapid	None	Good	Poor	High water table—Fragipan
Ruston	Moderate	Low	Good	Good	
Rains	Moderate	Low	Fair to Good	Poor	High water table—Fragipan
Savannah	Moderate to Slow	Low	Good	Fair to Poor	Fragipan
Susquehenna	Slow	Moderate	Fair to Poor	Poor	Clayey Subsoil
Bowie, Boswell					

[1] Permeability is that quality of the soil that enables it to transmit water. Rates are expressed in inches per hour.

Rapid — 5.00 to 10.00
Moderate — 0.20 to 5.00
Slow — less than 0.05 to 0.20

[2] Shrink-swell potential is the capacity of a soil to expand during a period of wet weather and then contract during a period of dry weather.

None — Will have no movement as it dries after it has been saturated with water.
Low — Will have very little movement during the wetting and drying process.
Moderate — Will have some movement during the wetting and drying process.

be very high. The available water holding capacity is low. They are used mostly for forest land.

Coxville Series: This series includes shallow soils over plastic clays of the Coastal Flatwoods. They have been developed from thick beds of fine sandy clays and clays. The depth to the clay is variable. The surface is a very dark-gray silt loam with a gray very firm clay subsoil that is mottled with red and yellow colors. Since Coxville soils have a shallow topsoil and a heavy plastic subsoil, the rate of runoff is high; the available water holding capacity is low. They are inherently low in fertility and very strongly acid. Soils of this series are best suited for pasture with limited grazing, or for trees. They have little value as agricultural soils.

Dunbar Loam: This series includes those soils of the Coastal Flatwoods that are medium-textured, moderately deep and somewhat poorly drained. These soils have been derived from thick beds of acid sandy clay loams and finer sandy loams. They are underlain by fine-textured clays. They have a surface of black, very fine sandy loam with a subsoil that is a pale-yellow silty clay loam that contains many distinct mottles of yellow, pink and red color. These soils are locally associated with the Norfolk, Coxville and Lynchburg. Dunbar soils occur on nearly level and gentle slopes with little to no erosion. The available water capacity is low. They are inherently very low in fertility and very strongly acid. During periods of dry weather these soils will respond to management and produce very good truck crops.

Eustis Series: This series includes very deep, excessively drained coarse sandy loams and loamy sands. These soils have been developed from thick beds of acid marine sands and in many cases, overlie finer textured sediments. This series is associated with the Lakeland, Ruston and Klej series. It has a dark gray, loose, loamy sand surface and a yellowish-brown loamy sand subsoil. Eustis soils are inherently low in fertility, have a low to very low available moisture capacity, and they are strongly acid. Due to high rainfall during the growing season in Jackson County, Eustis coarse sand loams and loamy sands are important to agriculture here. They are used mainly for watermelons, followed by pasture for 5 to 7 years, then another watermelon crop is grown.

Fairhope Series: These soils are moderately deep, somewhat poorly to moderately well-drained soils developed from beds of acid clays, fine sandy clays and clay loams. They have a brown very fine sandy loam surface with a yellowish-red firm loam to clay loam subsoil. Fairhope soils are associated with Boswell, Bayboro and Rains soils. They are inherently low in fertility and are very strongly acid. Also, they have a relatively low to moderate available moisture capacity. They occur in relatively small scattered areas of the Coastal Flatwoods and are not important to the agriculture of Jackson County.

Goldsboro series: This series includes deep medium-textured, moderately well-drained soils in both the Lower Coastal Plain and Coastal Flatwoods. They are formed from thick beds of unconsolidated acid sandy loam and sandy clay loams. The Goldsboro series is associated with the Norfolk, Lynchburg, and Ruston soils. The soils have a gray to grayish-brown loam surface and a yellowish-brown to olive-brown loam subsoil. They are strongly acid, inherently low in fertility, but with a moderate

Table 5—Estimated Average Yields of Principal Crops Under Good Management For The Soils of Jackson County.

Soil Type & Phase	Corn Bu.		Oats Bu.		Pastures, Acres Per Animal Unit[3]		Forest Site Indices[4]		
	A[1]	B[2]	A	B	A	B	Long Leaf	Lob-lolly	Slash
Bayboro silt loam	—	—	—	—	3	—	—	89	88
Bowie loam									
Nearly level phase	45	60	25	40	4	2½	85	90	89
Gently sloping phase	45	60	25	40	4	2½	85	90	89
Moderately sloping phase	35	50	20	35	5	3	85	90	89
Strongly sloping phase	—	—	—	—	—	—	75	85	82
Coxville silt loam	—	—	—	—	5	4	—	88	87
Dunbar loam									
Nearly level phase	—	—	—	—	4	3	93	95	90
Gently sloping phase	—	—	—	—	4	3	93	95	
Eustis loamy sands									
Gently sloping phase	45	55	30	40	4	2	75	—	89
Moderately sloping phase	45	55	30	40	4	2	75	—	89
Steeply sloping phase	—	—	—	—	—	—	75	—	88
Sandy and Clayey land									
Sloping phase	—	—	—	—	—	—	65-80	65-90	70-90
Steeply sloping phase	—	—	—	—	—	—	65-80	65-90	70-90
Eustis-Lakeland sands									
Gently sloping phase	—	—	—	—	—	—	68	—	—
Strongly sloping phase	—	—	—	—	—	—	65	—	—
Fairhope very fine sandy loam									
Nearly level phase	—	—	—	—	5	4	85	88	87
Gently sloping phase	—	—	—	—	5	4	85	88	87
Moderately sloping phase	—	—	—	—	5	4	80	82	81
Goldsboro loam									
Nearly level phase	50	60	30	40	4	2	80	94	93
Gently sloping phase	50	60	30	40	4	2	80	94	93
Moderately sloping phase	50	60	30	40	4	2	78	90	89
Klej loamy sands									
Gently sloping phase	50	60	30	40	4	2	70	89	85
Moderately sloping phase	50	60	30	40	4	2	70	89	85
Lakeland loamy sands									
Gently sloping phase	45	55	30	40	4	2	82	—	87
Moderately sloping phase	45	55	30	40	4	2	80	—	87
Steeply sloping phase	—	—	—	—	—	—	80	—	85
Lynchburg very fine sandy loam									
Nearly level phase	—	—	—	—	4	3	80	96	88
Gently sloping phase	—	—	—	—	4	3	80	96	88
Norfolk fine sandy loam									
Nearly level phase	50	80	30	60	4	1½	81	85	85
Gently sloping phase	50	80	30	60	4	1½	81	85	85
Moderately sloping phase	40	70	30	60	4	1½	76	80	80
Strongly sloping phase	—	—	—	—	4	2	76	80	80
Pheba loam									
Nearly level phase	—	—	—	—	4	2	74	90	89
Gently sloping phase	—	—	—	—	4	2	74	90	89
Plummer loamy sands	—	—	—	—	5	3	—	92	90
Rains dark surface loam phase	—	—	—	—	5	3	—	94	91
Orangeburg fine sandy loam									
Nearly level phase	50	80	30	60	4	1½	85	89	89
Ruston and Orangeburg fine sandy loams									
Nearly level phase	50	80	30	60	4	1½	83	89	89
Gently sloping phase	50	80	30	60	4	1½	83	89	89
Moderately sloping phase	—	—	—	—	—	—	74	80	80
Strongly sloping phase	—	—	—	—	—	—	70	75	75
Steeply sloping phase	—	—	—	—	—	—	70	75	75
Savannah loam									
Nearly level phase	45	60	25	40	4	2	85	90	90
Gently sloping phase	45	60	25	40	4	2	85	90	90
Scranton loamy sands									
Nearly level phase	—	—	—	—	4	2	—	95	90
Gently sloping phase	—	—	—	—	4	2	—	95	90
Susquehanna—Bowie & Boswell loam									
Gently sloping phase	—	—	—	—	5	4	77	83	81
Moderately sloping phase	—	—	—	—	5	4	72	81	80
Strongly sloping phase	—	—	—	—	—	—	72	81	80

[1] - Common Management

[2] - Good Management

[3] - An animal unit is equivalent to one mature cow, steer or horse, five hogs, or seven sheep or goats.

[4] - Height in feet when trees are 50 years old.

available moisture capacity. Under proper management these soils have considerable agricultural significance. Most of the corn and small grain in the county is produced on this soil.

Grady Series: These soils include a shallow moderately coarse textured to medium textured poorly drained soils over a clay in depression-like areas that occur in both major soil areas. Areas mapped in this county are commonly called Grady ponds which are conspicuous because of the dense growth of gum, bay, or cypress trees. Many areas have a slight slope from the outer rim to the center, but a fairly large number of areas are predominately level. Many of the depressions serve as collecting basins, or natural drainageways for seepage or runoff waters from adjacent slopes. In some saucer-like depressions, water stands on the surface a great part of the time and may remain most of the year. The surface texture may vary from a sandy loam to a silt loam while the subsoil may vary from a solid dark clay to a distinctly mottled gray clay. These soils are inherently low in fertility, very strongly acid and are of little use agriculturally.

Klej Series: This series includes deep coarse-textured moderately well-drained soils of the Lower Coastal Plain. These soils have been formed from thick beds of acid loamy sands and sandy clay loams. Klej soils are associated with the Lakeland, Norfolk, Eustis and Scranton soils. These series have a very dark grayish-brown loose coarse sandy loam with a brownish-yellow very coarse sandy loam in the subsoil. The Klej soils are inherently low in fertility with a low available moisture capacity. They are very strongly acid. With proper management, early truck-crops can be grown profitably.

Lynchburg Series: These soils include moderately deep to shallow, medium-textured somewhat poorly drained upland soils common to the Coastal Flatwoods. These soils are developed from unconsolidated beds of acid loamy sands and sandy loams. They are associated with the Norfolk, Goldsboro, Dunbar and Rains soils. They have a very dark-gray, very fine sandy loam surface with a pale yellow fine sandy loam subsoil that is mottled with brown and yellowish-red mottles. They have a moderate available moisture capacity. Lynchburg soils are low in inherent fertility and are very strongly acid. Under proper drainage the Lynchburg soils will improve as an agricultural soil.

Lakeland Series: This series includes very deep excessively drained and somewhat excessively drained coarse sandy loams and loamy sands. These soils were formed from thick beds of acid marine sands and loamy sands which in some cases overlie finer textural sediments. In this area, they are associated with the Norfolk and Eustis series. They have a dark grayish-brown loose loamy sand surface with a brownish-yellow sandy loam subsoil. They are inherently low in fertility and very strongly acid. Except as a place for early truck crops, they are not important to agriculture.

Norfolk Series: This series is composed of rather coarse-textured, well drained soils that have been formed from thick unconsolidated beds consisting chiefly of acid sandy clay loams, in which there are layers of sand, loamy sands, sandy loams and loams. In this area, they are associated with Lakeland, Bowie and Goldsboro. Soils in the Norfolk series have gray fine sandy loam surface

Where it can not be drained, Class Vw land (Rains loam) can be made productive by planting slash pine trees on it. Slash pine is well adapted to the wet, sandy "meadows" in Jackson County. (Courtesy of Soil Conservation Service)

with yellowish-brown sandy loam subsoil. They have a moderate available moisture capacity, and inherently low in fertility, and very strongly acid. They are some of the more important agricultural soils in the county.

Pheba Series: These soils were derived from unconsolidated beds of acid sands and sandy clays of the Coastal Plain. They include those soils having a medium-textured to moderately coarse-textured surface with a moderately coarse-textured surface with a moderately-fine textured subsoil over a fragipan. Pheba soils found in Jackson County have a very dark-gray loam surface with a mottled yellowish-brown clay loam over a weak pan in the subsoil. They are associated with the Lynchburg and Savannah soils. They are inherently low in fertility, with a moderate available moisture capacity. The Pheba series is very strongly acid. Since these soils occur in small areas throughout the county, they are not significant to the agriculture of Jackson County.

Plummer Series: This series includes coarse-textured, poorly to very poorly drained Low Humic Gley soils occurring in the Flatwoods area of the Gulf Coastal Plains. These soils were formed from thick beds of acid sands and loamy sands. They have a very dark-gray fine sandy loam surface and a grayish-brown sandy loam subsoil, mottled with pale-brown and yellowish-brown. These soils are of very little agricultural value because

Where it can be drained and when it has been fertilized, Class Vw land (Rains loam) will produce good pasture for livestock. (Courtesy of Soil Conservation Service)

of their sandy texture and poor drainage. Water stands on them for long periods during wet seasons. Surface drainage is usually difficult since the soils occur primarily on level or nearly level relief. The water table usually prevents downward movement of the water. Plummer soils are inherently very low in fertility and have very poor moisture and plant relations. They are very strongly acid.

Rains Series: This series includes poorly to very poorly drained soils formed from thick beds of acid sandy loams and sandy clay loams of the Lower Coastal Plains. They have a black surface texture of very fine sandy loam and mottled gray and yellowish-brown sticky sandy clay subsoil. They are associated with the Plummer, Scranton, and Lynchburg soils. They have a moderate available moisture capacity and are inherently low in fertility. Rains soils are very strongly acid. Without good drainage, these soils have little or no agricultural value except for pasture and trees.

Orangeburg Series: This series includes the well drained soils developed from beds of unconsolidated acid sands and sandy clays of the Lower Coastal Plain. They have a brown surface; however, there is a tendency for some of the surfaces in this area to be grayer than modal. The surface is fine sandy loam and the subsoil is red firm sandy clay loam. Orangeburg soils are inherently moderate in fertility, have a moderate to good available moisture capacity, and are very strongly acid.

These soils occur mostly in the northeast section of Jackson County near the George County and Alabama line. When they occur, these soils are important to the agriculture of this County. Orangeburg soils seldom occur on slopes greater than 2 percent.

Ruston and Orangeburg Series: Soils in this unit are very deep, moderately coarse-textured well drained soils developed from friable coastal plain acid sandy loams and sandy clay loams. They have a grayish-brown sandy surface. Ruston soils have a reddish-brown or yellowish-red sandy clay loam to sandy clay subsoil. Orangeburg soils have a red sandy clay loam to sandy clay subsoil. They have a high available moisture capacity and in general a good water-plant relationship exists. They are moderate in inherent fertility and are very strongly acid. These soils are considered to be among the best soils in the county. From an agricultural standpoint, they are very important.

Savannah Series: This series includes medium-textured, moderately deep over a fragipan, moderately well drained soils. They were developed from unconsolidated beds of acid sands and sandy clays of Coastal Plains origin. The surface is a dark grayish-brown loam to silt loam while the subsoil is a yellowish-brown loam. The Savannah soils are associated with Norfolk, Ruston and Goldsboro. They are moderate in inherent fertility and have a moderate available moisture capacity. Savannah soils are very strongly acid. In the northeast part of the county they have a considerable agricultural significance.

Scranton Series: This series includes those deep, moderately coarse-textured, somewhat poorly drained to poorly drained soils occurring in the red-yellow podzolic region. These soils have been developed from thick beds of acid loamy sands and sandy loams in the Flatwoods area of the Coastal Plains. In this area, they occur with a very dark gray very friable, very fine sandy loam with a subsoil of a pale-yellow, very mottled friable loamy sand. Scranton soils occur on level to gently sloping land. They are inherently low in fertility, very strongly acid, and they have a very low available moisture capacity.

Susquehanna Series: These soils are derived from thick beds of acid clays. They are associated with Boswell soils. These series have a gray fine sandy loam surface with a reddish-brown mottled silty clay to clay subsoil at 5 inches deep. The Susquehanna soils are inherently low in fertility and very strongly acid. Due to these characteristics, they are not used for row crops, but are best suited to grass and trees.

Land Types

Alluvial Lands: This land type is primarily found in the bottoms along the Pascagoula and Escatawpa Rivers. Bottoms included in this unit are overflowed several times nearly every year. The surface layers range from a sand to a silty clay with a subsoil of stratified material that may range from a loamy sand to a silty clay. Soils in this unit are heavily forested with a considerable area of burned, cutover timberland that has become a dense entanglement of vines, briers and brush. Trees found in this area include the cypress, tupelo gum, black gum, sweetgum, willow oak, water oak, ash, ironwood, with some holly, over cup oak, live oak, and an occasional spruce pine. There are a few hammocks of loblolly pine.

Coastal Beach: Coastal Beach is composed entirely of sand. It occurs in a relatively narrow band along the beach of the Mississippi Sound. The slope has a range of 0 to 5 percent. The surface contains single grains of white, yellow, pale-brown and black sand. Below 36 inches the pale brown, loose, coarse sand has no reaction to the acidity test. The Coastal Beach has little value to agriculture, but is used for recreation and wildlife.

Dune Sand: Dune sand is composed entirely of sand. It occurs on the islands that border the coast line of Jackson County. It is different from Coastal Beach in that it occurs in mounds up to 20 to 25 feet high. It is shifted from time to time by water and high winds during storms.

Swamp: This includes moderately deep, coarse to medium textured poorly drained conditions occurring along stream bottoms, depressional areas, and intermittent drainageways. Soils in this unit usually contain a relatively high amount of organic matter and may be stratified with mineral soil. With normal rainfall, water may stand on or above the surface most of the year. Characteristic vegetation is a dense growth of bay, tupelo gum, titi, bamboo and gallberries. Soils included in this swampy condition are usually inherently low in fertility, have a variable available moisture capacity. They are strongly acid, and they occur on level to gentle slopes.

Tidal Marsh: Tidal marsh comprises several large areas in Jackson County, the most important two being the broad strip extending several miles up the lower Pascagoula River and its tributaries and that in the southeastern corner of the county. The marsh has a very variable surface and subsoil. It varies from a black mucky-type soil to a dark gray silty clay. The area comprising the Pascagoula River marsh is cut up with meandering streams and bayous causing large areas of marsh to be isolated from other lands. A dense growth of big cord grass, smooth cord grass and common reed comprises most of the area in the Pascagoula River marsh.

Methods Used in the Soil Survey of Jackson County

You can't just look at the topsoil and tell the type land that you own. You must look inside, examine the layers that are under the surface and interpret what you find.

Soil scientists walked over each field in the county and examined the soils frequently by boring holes with an auger or digging with a spade. They also studied exposures of soils in banks, road cuts and pits in the county.

Each boring or hole revealed a series of distinct layers. These layers are called horizons and collectively form the soil profile. The A horizon consists of the surface soil and subsurface soil; the B horizon, the subsoil; and the C horizon, the parent material from which the soil is formed. Arrangements and thickness of the different layers or horizons help to characterize the soil.

Properties such as texture and color usually vary in the different layers, or horizons, of the soil. The surface layer is usually gray or brownish gray and the subsoil darker in color. Mottling is usually greater in the lower layers than the surface. The following characteristics were considered:

Texture: The content of clay, silt and sand in a soil determines its texture. Texture is first judged by the feel and to some extent by the appearance of the soil. This may be later checked mechanically by laboratory analysis. The finest particles in the soil are called clay. Individual clay particles are so fine that they can scarcely be seen with a microscope. Soils that consist principally of clay are usually sticky when wet and rather hard when dry. Water moves slowly through clay soil; they retain moisture and plant nutrients well, but may not release them for plants.

Silt is the medium-sized particles which are large enough to be seen with a microscope. These soils are smooth and velvety; they are not so hard when they dry and are not so sticky when wet as clay soils.

Sand is the largest of the particles that make up a soil. You can see the individual particles with the naked eye. Water moves rapidly through sandy soils and they hold very little water for the use of the plants. For

Table 6—Mapping Units, Total Acres, and Percent of Jackson County Soils

Mapping No.	Soil Name	Total Acres	% County
18	Swamp	3.360	11.0
19	Alluvial land	7.346	9.7
31A1	Ruston and Orangeburg fine sandy loam	3.834	.8
31B1		12,627	2.6
31C1		3,786	.8
31D1		1,809	.4
31E1		476	.1
32A1	Orangeburg fine sandy loam	488	.1
33A1	Norfolk fine sandy loam	3,382	.7
33B1		19.160	4.0
33C1		5.261	1.1
33D1		1,380	.3
41A1	Savannah loam	551	.1
41B1		627	.2
43A1	Bowie loam	3,262	.7
43B1		7,973	1.7
43C1		4,795	1.0
43D1		862	.2
44A1	Pheba loam	3,494	.7
44B1		897	.2
57(0-5)1	Lakeland loamy sands	3,008	.7
57(5-8)1		1,057	.2
57(8-17)1		324	.1
58(0-5)1	Eustis loamy sands	12,399	2.5
58(5-8)1		1,713	.4
58(8-17)1		815	.2
59(0-8)1	Eustis and Lakeland sands	2,486	.5
59(8-12)1		357	.1
60A1	Goldsboro loam	17,368	3.6
60B1		34,858	7.1
60C1		6,187	1.3
62A1	Fairhope very fine sandy loam	367	.1
62B1		1,332	.3
62C1		568	.1
63A1	Lynchburg very fine sandy loam	15,378	3.2
63B1		14,472	3.0
64A1	Dunbar loam	7,287	1.6
64B1		1,047	.2
65A1 (77)	Rains loam, dark surface phase	50,177	10.3
65B1		4,574	1.0
67-76	Bayboro silt loam	9.896	2.0
68A1	Coxville silt loam	5.376	1.1
68B1		468	.1
75(0-5)1	Klej loamy sands	18,409	3.8
75(5-12)1		5,772	1.2
78A1	Scranton loamy sands	6,438	1.4
78B1		809	.2
79	Plummer loamy sands	14,432	3.1
74	Plummer loamy sands, dark surface phase	1,904	.4
82B1	Susquehanna, Bowie and Boswell loam	5.926	1.3
82C1		7,030	1.5
82D1		4,114	.9
90C1	Sloping sandy and clayey land	3,332	.7
90D1		4,764	1.0
90E1	Steep sandy and clayey land	5,138	1.1
91	Grady soils	974	.2
99	Tidal marsh	24.117	4.9
100	Coastal Beach sand	2.861	.6
101	Dune sands	1.819	.4
	Made land	1,500	.3
	Misc.		.8
		476,160	100.0%

In Jackson County, a corn-Bahia rotation is the most used farming practice. (Courtesy of Soil Conservation Service)

this reason, extremely sandy soils are very droughty and would be of very little use agriculturally except for the high rainfall that occurs during the growing season here in Jackson County.

Structure: This is the arrangement of the individual soil particles into aggregates. When dry some soils are loose and crumbly; others can be broken into block-like clods and still others have small platelike pieces. The structure of a soil determines how air, water and roots penetrate the soil.

Drainage: Color of the subsoil indicates the type of internal drainage a soil has. In Jackson County, there is a wide range in drainage, which causes differences in crop suitability. The terms used to indicate drainage are excessively drained, well-drained, moderately well-drained, somewhat poorly, and poorly drained.

Color: Besides drainage, color indicates the amount of organic matter that is in a soil. In Jackson County most of the black surfaces soils are caused by organic matter and stains from the charcoal and many forest fires in the woods. Well-drained soils have either red, yellow or brown colors; whereas, the somewhat poorly drained soils have gray or red mottlings appearing at 18 inches.

Chemical Properties: They tend to indicate the way in which soils were formed. Since most of Jackson County is recent marine deposits, you will find the soils to be low in fertility, strongly acid and sandy.

Topography or lay of the land: Definite combinations of soil profile characteristics are usually associated with topography. Some soils always occur in the wide flats, locally called meadows, while other soils occur on the sharp breaks along the bayous in the county. Different combinations of these soil characteristics are the basis for separating one soil from another. The kinds of soil were classified into soil series, type phases, complexes and undifferentiated units.

Soil Series: These are groups of soils similar in almost every respect except the texture of the surface layer. Therefore, a series is composed of soils with essentially the same color, structure and other important internal characteristics, the same natural drainage conditions and the same range in relief.

Within a soil series are one or more soil types, defined according to the texture of the surface layer. Thus the class name of the soil texture, such as sandy loam, silt loam or loam is added to the series to give the complete name of the soil type.

One soil type may occur on several different slopes and have different degrees of erosion. These differences in slope and erosion are shown by the use of soil phases. For example,

This road serves as an access road, a drainageway, and a fire break. (Courtesy of Soil Conservation Sevice)

Goldsboro loam, gently sloping phase (slope, 2 to 5 percent) and Goldsboro loam, moderately sloping phase (slope 5 to 8 percent) are two phases of the same soil type. These two phases have different management problems. The greatly sloping phase can be cultivated; whereas, the moderately sloping phase is too steep for practical cultivation.

Some of the soils are placed in soil areas called **complexes.** These are areas where two or more soils that are associated together are found in such an intricate pattern that separation is impractical. They are mixtures of soils and a model profile cannot be defined. (Example—Susquehanna, Bowie and Boswell soils.)

At times you will find profiles which do not occur in regular geographic associations. You may find one or both of the soils together, but you could not separate them. These are placed in a unit known as an **undifferentiated soil unit.** (Example—Eustis and Lakeland Sands.)

Miscellaneous land types are used in soil classification and mapping for areas where the soils are so intricately associated that it is impossible to classify them or where there is not a definite soil profile. Alluvial Soils, Coastal Beach, and Tidal Marsh are examples of Miscellaneous land types.

In making the map of this County, soil surveyors have shown the location of each of the soil types, phases, complexes and undifferentiated units in relation to roads, houses, streams, lakes and other local cultural and natural features of the landscape.

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Dates Of Calving In A Beef Cattle Management Study

MISSISSIPPI STATE UNIVERSITY
AGRICULTURAL EXPERIMENT STATION
HENRY H. LEVECK, Director
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Summary

These results indicate that all three calving systems may be used satisfactorily. The one selected should largely be determined by the method of wintering which is best suited to individual operations, whether quality summer pasture will be provided, and the program of marketing calves. Satisfactory results from year-round calving will require emphasis on both the summer pasture program and the winter program. Fall calving will require primary emphasis on the winter program. Providing good summer pasture appears to be the major factor in late-winter calving.

On the cover:

Part of the original group of heifers used in the study. Ten years later 26 of the original 75 were still in production.

DATES OF CALVING IN A BEEF CATTLE MANAGEMENT STUDY

By E. G. MORRISON[1]

The time of year calves are dropped is important to every owner of a brood cow herd. Percentage calf crop, weaning weight, grade, sale price, production costs, pasture and forage utilization, and weather are important factors which should influence the selection of a calving period on individual operations. In Mississippi calves may be dropped at any time of the year.

A wide variation of calving dates in actual practice, much controversy as to which is the best calving season, and keen interest for improvement by the producer prompted the initiation of a dates of calving study at the Brown Loam Branch Experiment Station.

The study was conducted to determine what differences exist between these calving periods: Year-Round, Fall, and Late-Winter. The material presented covers the years 1949-1959.

Experimental Procedure

Seventy-five high grade Hereford heifer calves were purchased in the fall of 1947 and were grazed on oat pasture during the winter. The following summer they were divided into three uniform groups of twenty-five head each to begin breeding for calving at different seasons of the year.

The fall calving group was bred in the winter of 1948-49 so their first calves would be dropped in the fall of 1949 (September, October, and November). Another group was bred in the late spring of 1949 so their calves would come in late-winter (January, February, and March, 1950). Controlled breeding for the above calving dates was maintained throughout the test. The third group was bred on a year-round basis. This was accomplished by putting two or three heifers with a bull each month during the first twelve month period. A bull then remained with this group at all times throughout the study. All groups were pasture bred to registered Hereford bulls during the entire test. As the study progressed, herds were maintained by selecting the best heifers for replacements.

When the study began, each cow was hot-branded with a number so individual production records could be maintained. At birth each calf was dehorned, and ear numbered. Records were kept on birth weight, sex, date of birth and the dam's number. All calves were individually weighed at monthly intervals until weaning time and all cows were individually weighed at monthly intervals. Year-round and fall-dropped calves were weaned when nine months old. Late-winter calves were eight and one-half months old at weaning. All calves were evaluated at weaning time.

The fall and year-round herds with their calves were wintered on oat-ryegrass pasture on a limited grazing basis. This system required one acre of good winter pasture per cow and permitted grazing for three to four hours daily. The animals were on dry Bermuda-Dallisgrass pasture the remaining time. The only additional feed used was a limited amount of hay during severe weather or when forage was short because of long periods of low temperatures. The late-winter calving herd was wintered on stacked pasture clippings or baled grass hay and one pound of cottonseed meal per head daily. No shelter other than natural cover was provided. All herds grazed common Bermuda-Dallisgrass pastures during the summer months. Block salt was the only mineral provided and creep feeding was not practiced.

Data shown in the several tables are

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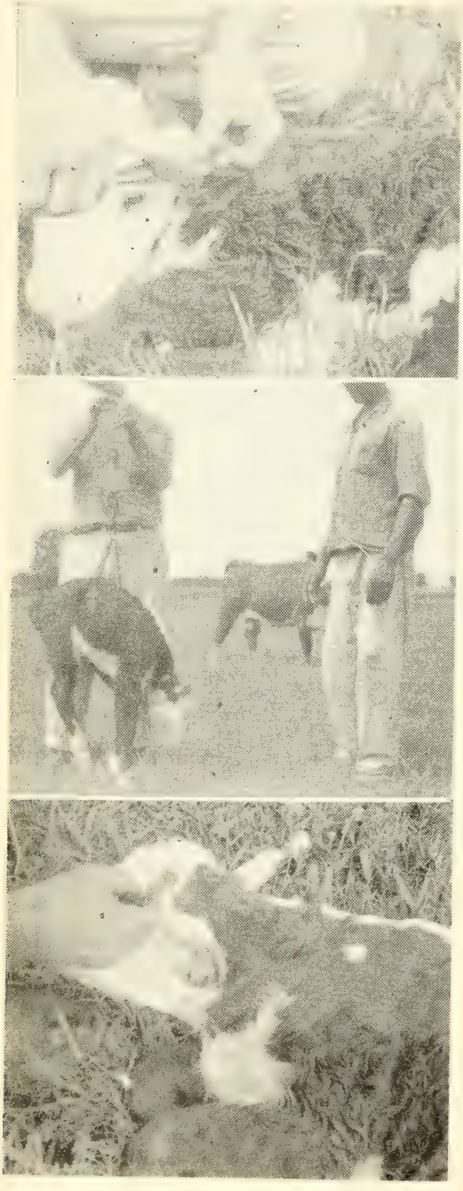
[1] This report covers research conducted by Ray H. Means and John B. Gill in addition to the author.

presented as weighted averages. Weaning weights have not been adjusted. Average daily gain of calves was calculated by subtracting birth weight from weaning weight and dividing the remainder by the calf's age in days. Animal weights in all cases are on a full basis.



Methods used for ear numbering, weighing and dehorning calves.

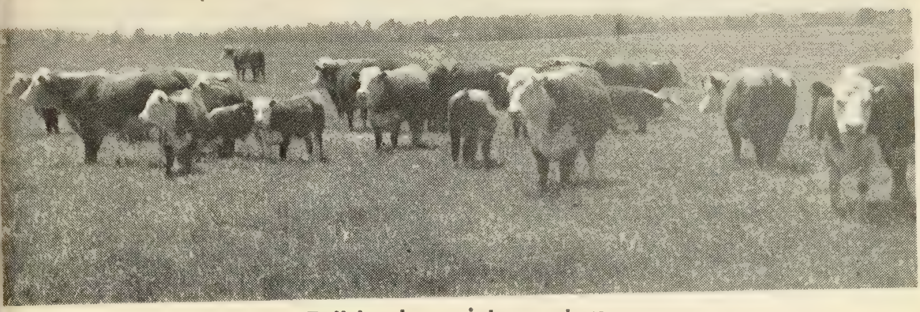
Year-Round System

Production of the year-round calving herd is presented in Tables 1 and 2. The birth dates of the 218 calves produced by this herd were unevenly distributed during the twelve months. During the January through July period 77 percent of the calves were born, with only 23 percent dropped during August through December. This indicates that if cows are allowed to breed at will a much lower percentage will breed during the winter months of November through March than at other times of the year.

Most breeders practicing year-round calving dislike summer-dropped calves. In this study nearly 39 percent of year-round calves came during May through August and 56 percent during April through September. Winter grazing was provided this herd and calves were not weaned until nine months of age. Therefore, the summer-dropped calves with some age on them had access to excellent pasture for a lengthy period. These calves gained faster and weaned heavier than calves dropped earlier in the year which had little if any access to winter pasture.

Considerable variation in birth weights by months occurred in the year-round calves. July, August, and September calves had much lighter birth weights than calves dropped during other months. This lower birth weight had no apparent effect on growth rate or weaning weight. Percentage calf crop was highest for the year-round herd. This is to be expected since a bull remained with these cows at all times.

Although a small increase in percentage calf crop was obtained, a much greater management problem is involved in this system. Cows require closer attention with calves coming at all times. Calves must be brought in every few months for vaccination, castration, and weaning.



Fall herd on winter pasture.

This system is not well adapted to a program of carrying calves to heavier weights since it would be rather difficult to put together a uniform group to feed or graze. Marketing calves at weaning appears to be the best program with this system.

Fall System

Production of fall calving herd is presented in Tables 3 and 4. These cows were bred during December, January, and February while on winter pasture. A high percentage of cows settled in the first month of breeding which is shown by the 69 percent calf drop in the first month of the controlled calving period. Fall calves were lighter at birth than those produced in the other systems. This agrees with the data on birth weights from the year-round calving herd in which late summer and fall dropped calves had lighter birth weights. Fall calves were weaned in June and July each year at a full nine months of age. These calves with their dams had access to good winter pasture during a majority of this period. The high level of nutrition and greater weaning age are the two factors responsible for a slightly faster daily gain and heavier weaning weight in the fall dropped calves. There is less year to year variation in calving percent of the fall herd.

The fall season appears to be the least hazardous time for calves to come since inclement weather is a major factor in losing calves. During the entire study only eight calves were lost in the fall herd whereas fourteen were lost in the late-winter group and sixteen in the year-round herd. The lighter birth weight for fall calves could be an advantage at calving time.

Fall calves offer more flexibility than year-round calves although they might best be marketed when weaned because of higher prices. Calves weaned in June and July must go to excellent pasture or on grain or they will lose weight. If these calves are of such quality to justify carrying to heavier weights before marketing, they can go on winter pasture or feed and gain very rapidly. If grazed on winter pasture, they will sell in the spring at eighteen months of age weighing about 900 pounds in the Good Grade.

Late-Winter System

Production of the late-winter calving herd is shown in Tables 5 and 6. Calving percentage was lowest under this system. The monthly drop of calves shows that a majority of cows bred during the early part of the breeding season. Birth weights increased as the calving period progressed. These cows were wintered on grass hay and cottonseed meal. Therefore, the level of winter nutrition was not as high as in the year-round and fall calving herds. These calves were weaned in mid to late October when pastures are rather poor. Calves are beginning to lose their bloom at this time of year and must be weaned before pastures go out completely.

Late-winter calving herd being wintered on stacked hay.

Under this system calves were weaned at an average age of eight and one-half months. This lower nutritive level and shorter weaning age accounts for a lower average daily gain and weaning weight in these calves.

Late-winter calves seem better adapted to a carry-over program than calves from the other systems. If marketed at weaning time in October, these calves are sold on the lowest market of the year. Carrying these calves over on winter pasture is ideal since good pasture can be immediately available following weaning. They will come off winter pasture in the spring weighing 700 pounds or more grading High Standard and Low Good. They can then be sold for slaughter or as feeders on a market which is normally higher than when weaned or they may be finished on grain.

In controlled breeding programs, cows which consistently calve in the early part of the calving period are most valuable from a production standpoint. In Table 3 it is shown that November calves weaned 40 pounds lighter than September and October calves. Also, in Table 5 April calves were 80 pounds lighter at weaning than January and February calves. These late calves are necessarily weaned at an early age since pasture quality at the particular weaning time is a limiting factor.

Costs and Returns

Total average production and financial results are summarized in Table 7. Differences in value per hundredweight at weaning were rather small. Fall calves sold for only $1.00 per hundred higher than late-winter calves with year-round calves intermediate. The lower weaning weight and per hundred value of late-winter calves resulted in a per head value of $14.00 less than fall calves and nearly $10.00 less than year-round calves.

A major difference between systems in winter feed cost per cow is shown. With one acre of winter pasture costing $27.00 and $3.00 worth of hay fed at odd times, the total winter cost for fall and year-round cows was $30.00 per head. This compares to $18.30 per cow for stacked or baled grass hay and cottonseed meal for late-winter cows.

When winter cost per cow is deducted and adjustment made for calving percentage, differences in value per calf between herds become rather small. Fall calves are worth $4.00 per head more than late-winter calves with year-round calves intermediate. The increased winter cost for fall and year-round cows is more than offset by heavier weaning weights and sale price of their calves over the late-winter system.

Fall and year-round herds do not necessarily have to graze the winter pasture completely out. Cows may be moved to good clover pasture in March and the winter pasture utilized by steers or it may be cut for hay. Should either practice be followed the full winter pasture cost should not be charged to the cows. However, a good winter pasture program with controlled grazing appears highly essential to the year-round and fall calving systems. Winter pasture is the main factor responsible for the better performance of calves from these herds.

Calving interval was summarized for the three herds and is shown below:

	Calving interval (Av. No. days)
Year-round	352
Fall	373
Late-winter	367

It was obtained by calculating the average number of days between birth dates of calves by the same cow. This should give some measure of the reproductive efficiency between herds. Year-round cows are shown to be the most efficient in this study, averaging 352 days between calvings. Fall cows had the longest interval of 373 days. The difference of six days in calving interval of fall and late-winter cows is too small to be of any consequence.

Weight of Cows

A comparison of average monthly weight changes between herds is shown in Figure 1. Fall and year-round cows maintained heavier weights than late-winter cows at all times. This is no doubt due to the higher level of nutrition provided by the winter pasture. These cows stayed in excellent condition throughout each year. Late-winter cows were rather thin during March which is the end of both the winter and calving periods. A much wider weight variation during the year is shown by the fall cows.

One factor which should be considered

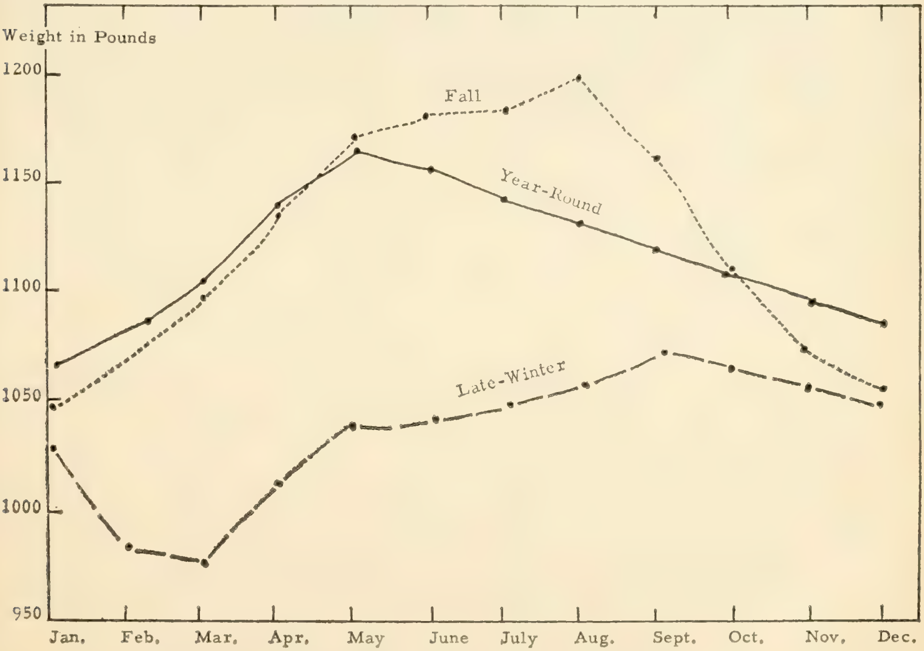


Figure 1. Average monthly weight changes of cows.

at this point is cow salvage value upon removal from the herd. Since fall and year-round cows maintained a heavier weight than late-winter cows, they therefore would bring a higher average price when culled. A large number of cows are removed from the herd when calves are weaned. Fall calves were weaned in June and July with late-winter calves weaned in October. At this time fall cows show a weight advantage of 115 pounds over late-winter cows. Also cow prices in June and July are somewhat higher than in October.

Of the twenty-five original cows in each herd when the study began, twelve year-round, eight fall, and six late-winter cows were still in production at the end. Ten calf crops were obtained from fall and late-winter cows and nine from the year-round group.

Records in this study involve 349 male calves and 353 heifer calves. When calves from all herds are combined males were 3.25 pounds heavier than females at birth, 33.7 pounds heavier at weaning, and gained 0.12 pounds per days faster from birth to weaning. Since uneven numbers of male and female calves were produced in each herd and calf performance has not been adjusted for sex differences, this factor should be considered when comparing the differences between herds. There were 5.5 percent more males than females produced by the year-round herd and 1.6 percent more males by the fall group. On the other hand, eight percent more females than males were produced by the late-winter herd. If results were adjusted to remove sex differences, average performance of year-round calves would decrease, that of fall calves would change very little, and performance of late-winter calves would increase. Therefore, the average differences in production by herds are not actually as large as shown.

Table 2. Yearly production of year-round calving herd, 1949-58.

9-1 to 9-1 Yr. calves born	Calving percent	Birth weight	Weaning weight	Age at weaning days	Daily gain birth to weaning	Value per cwt. at weaning	Value per head at weaning
1949-50	96.00	64.6	487	265	1.62	31.75	154.62
1950-51	112.00	66.4	469	266	1.52	31.97	149.94
1951-52	91.33	66.4	499	263	1.65	22.07	110.13
1952-53	100.00	66.7	523	271	1.68	17.88	93.51
1953-54	100.00	65.0	494	282	1.52	18.83	93.02
1954-55	86.21	67.8	467	274	1.46	18.38	85.83
1955-56	87.50	74.9	445	276	1.39	18.25	81.21
1956-57	92.86	69.0	404	253	1.34	23.29	94.09
1957-58	83.87	67.4	364	255	1.17	30.91	112.51
Average	94.42	67.5	460	267	1.48	23.84	108.47

Table 4. Yearly production of fall calving herd, 1949-58.

Year calves born	Calving percent	Birth weight	Weaning weight	Age at weaning, days	Daily gain birth to weaning,	Value per cwt. at weaning	Value per head at weaning
1949	85.00	56.9	460	282	1.43	27.84	128.06
1950	92.00	65.8	496	276	1.56	33.21	164.72
1951	92.00	63.5	506	275	1.61	30.13	152.46
1952	92.00	69.1	475	269	1.51	16.43	78.04
1953	93.33	61.8	478	270	1.55	17.61	84.18
1954	93.75	64.2	485	258	1.63	19.41	94.14
1955	92.86	63.2	494	270	1.60	17.68	87.34
1956	95.83	62.1	466	270	1.50	22.05	102.75
1957	93.33	57.2	384	278	1.18	29.07	111.63
1958	83.33	61.2	491	275	1.56	31.51	154.71
Average	91.34	62.6	473	271	1.52	24.13	113.19

CONCLUSIONS

Year-Round System:

1. A slightly higher percentage calf crop was obtained with better reproductive efficiency.
2. Cows must be wintered on a high level of nutrition.
3. Winter cost per cow was $30.00 with one acre of winter pasture on a controlled grazed basis required for each cow.
4. Nearly 80 percent of the calves were born during the first seven months of the year.
5. Nearly 40 percent of calves were born during the May through August period when normally calves are not wanted. Where winter grazing is provided, these calves gain faster and wean heavier than calves dropped earlier in the year.
6. A greater management problem is involved.
7. Marketing calves at weaning appears to be the best program since this system is not well adapted to carrying calves to heavier weights.

Fall System:

1. Cows must be wintered on a high level of nutrition.
2. Winter cost per cow was $30.00 with one acre of winter pasture on a controlled grazed basis required for each cow.
3. Calves weighed less at birth.
4. Calves weaned heavier and sold for the highest price per hundred.
5. Calves might best be marketed when weaned due to higher prices.
6. Calves can easily be carried to heavier weights, however, excellent pasture or grain is necessary at weaning or loss of weight will occur.
7. The fall season appears to be the least hazardous time for calves to come.
8. Cows have the highest salvage value when culled.

Late-Winter System:

1. Calves weaned lighter than those from fall or year-round systems.
2. If marketed at weaning, calves sell on the lowest market of the year.
3. Production cost per calf is lower than that of calves born at other seasons of the year.
4. Calves seem better adapted to a program of carrying to heavier weights than calves from other systems. At weaning these calves fit well into a winter grazing program.
5. Winter cost per cow using grass hay and cottonseed meal was $18.30.
6. A shorter wintering period is involved.
7. The total management requirement is lower.
8. Cows have the lowest salvage value when culled.

Table 6. Yearly production of late-winter calving herd, 1950-59.

Year calves born	Calving percent	Birth weight	Weaning weight	Age at weaning, days	Daily gain birth to weaning	Value per cwt. at weaning	Value per head at weaning
1950	84.00	63.7	429	236	1.54	29.05	124.62
1951	95.00	63.4	447	255	1.51	33.00	147.51
1952	90.00	68.5	454	247	1.56	23.81	108.10
1953	89.66	66.4	419	248	1.42	14.58	61.09
1954	84.62	62.5	483	289	1.46	18.54	89.55
1955	93.10	65.8	447	259	1.47	18.61	83.19
1956	90.62	67.2	440	273	1.37	17.36	76.38
1957	96.67	64.6	384	245	1.31	22.30	85.63
1958	82.76	64.7	393	247	1.35	30.72	120.73
1959	86.67	65.0	410	264	1.31	28.16	115.46
Average	89.31	65.2	429	257	1.42	23.17	98.82

Table 1. Monthly production of year-round calving herd, 1949-58.

Month calf born	Calves per month			Birth wt. by sex		Average birth wt.	Weaning wt. by sex		Average weaning wt.	Daily gain birth to weaning		Average da. gain birth to weaning	Age at weaning, days		Average age at weaning, days
	male	female	total	male	female		male	female		male	female		male	female	
January	12	10	22	65.8	64.3	65.1	432	400	418	1.39	1.28	1.34	264	263	264
February	7	10	17	73.3	71.3	72.1	473	446	457	1.56	1.49	1.52	255	251	253
March	18	12	30	74.9	66.8	71.7	456	385	428	1.58	1.29	1.46	240	244	242
April	10	14	24	71.0	72.9	72.1	464	409	432	1.41	1.24	1.31	278	272	275
May	18	5	23	73.9	67.0	72.4	444	435	442	1.34	1.30	1.33	264	284	268
June	8	13	21	71.1	71.7	71.5	539	495	512	1.73	1.56	1.63	281	279	280
July	13	17	30	65.3	56.8	60.5	503	443	469	1.61	1.41	1.50	272	276	274
August	8	2	10	59.8	52.0	58.2	481	472	479	1.52	1.55	1.53	277	272	276
September	5	9	14	57.0	57.7	57.4	531	444	475	1.73	1.40	1.52	276	276	276
October	8	5	13	65.1	62.2	64.0	510	510	510	1.62	1.75	1.67	274	256	267
November	4	3	7	71.2	62.7	67.6	552	457	511	1.86	1.54	1.72	258	257	258
December	4	3	7	62.5	71.0	66.1	470	502	484	1.48	1.57	1.52	277	276	277
Total	115	103	218												
Average				68.9	65.5	67.5	477	443	460	1.53	1.41	1.48	267	267	267

Table 3. Monthly production of fall calving herd, 1949-58.

Month calf born	Calves per month			Birth wt. by sex		Average birth wt.	Weaning wt. by sex		Average weaning wt.	Daily gain birth to weaning		Average da. gain birth to weaning	Age at weaning, days		Average age at weaning, days
	male	female	total	male	female		male	female		male	female		male	female	
September	85	83	168	62.0	60.0	61.0	495	459	477	1.55	1.43	1.49	279	278	279
October	32	27	59	67.3	64.2	65.9	489	455	473	1.62	1.49	1.56	261	263	262
November	6	9	15	68.2	68.3	68.3	428	438	434	1.62	1.67	1.65	224	223	223
Total	123	119	242												
Average				63.7	61.6	62.6	490	456	473	1.57	1.46	1.52	272	270	271

Table 5. Monthly production of late-winter calving herd, 1950-59.

Month calf born	Calves per month			Birth wt. by sex		Average birth wt.	Weaning wt. by sex		Average weaning wt.	Daily gain birth to weaning		Average daily gain birth to weaning	Age at weaning, days		Average age at weaning, days
	male	female	total	male	female		male	female		male	female		male	female	
January	41	48	89	65.8	60.8	63.1	439	436	437	1.37	1.33	1.35	272	282	277
February	38	44	82	68.1	64.6	66.2	465	421	441	1.53	1.36	1.44	259	263	261
March	27	29	56	67.5	65.4	66.4	443	399	420	1.59	1.40	1.49	235	238	237
April	5	10	15	75.6	63.3	67.4	352	360	357	1.50	1.49	1.49	183	200	194
Total	111	131	242												
Average				67.5	63.3	65.2	445	417	429	1.49	1.37	1.42	254	259	257

Table 7. Total average production and financial results.

Time of calving	Calving percent	Birth wt.	Weaning wt.	Average daily gain	Weaning age, days	Value per cwt. at weaning	Value per calf at weaning	Winter cost per cow	Return above winter cost	Return adjusted for calving percentage
	%	lbs.	lbs.	lbs.	days	$	$	$	$	$
Year-round	94.42	67.5	460	1.48	267	23.84	108.47	30.00	78.47	74.09
Fall	91.34	62.6	473	1.52	271	24.13	113.19	30.00	83.19	75.99
Late-winter	89.31	65.2	429	1.42	257	23.17	98.82	18.30	80.52	71.91

Statistical Analysis

The data in this report has been analyzed by the analysis of variance technique described by Snedecor (1956) and the significance of means was tested by Duncan's New Multiple Range Test, Duncan (1955). The analysis was based on comparable years. Results of this analysis are presented in Table 9.

Table 9: Statistical analysis of data.[1]

Time of calving	Calving percent	Birth wt.	Weaning wt.	Average daily gain	Weaning age, days	Value per cwt. at weaning	Value per Calf at weaning[2]
Year-round	94.42a	67.58b	461.3ab	1.48a	267.2a	23.70a	108.32ab
Fall	92.05a	63.12a	475.0a	1.52a	271.2a	24.12a	114.44a
Late-winter	89.60a	65.20ab	432.9b	1.44a	[illegible]	23.11a	99.64b
C. V. (%)	5.8	4.3	6.3	6.6	4.3	9.8	12.4

[1] Any two means which have the same letter in common do not differ significantly at the 5% level of probability.

[2] Significant at the 10% level of probability.

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BROWN LOAM
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MISSISSIPPI AGRICULTURAL
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The research reported in this bulletin was done at the Brown Loam Branch Experiment Station at Oakley in Hinds County.

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Permanent vs. Temporary Summer Pastures For Milk Production

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MAY 26 1962
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Summary

Milk production per cow was higher and persistency of production greater for cows while grazing Sudan grass than while grazing either Coastal Bermuda or Dallis grass. Dallis grass was higher in quality than Coastal Bermuda.

Coastal Bermuda pasture provided more cow-days and produced more nutrients per acre at a lower feed cost per 100 pounds of milk than did either of the other two grasses. These differences were greater during dry years, indicating a greater drought resistance for Coastal Bermuda.

In a situation where daily production per cow is more important than total yield per acre greater emphasis must be put on the higher quality temporary pasture crops.

PERMANENT VS. TEMPORARY SUMMER PASTURES FOR MILK PRODUCTION

By C. B. BROWNING, W. C. COWSERT, W. D. CRAFT and J. T. MILES

Most dairymen are convinced that summer pasture crops offer the cheapest source of feed for milk production. However, the choice between temporary pasture (summer annuals) and permanent pasture (summer perennials) is often difficult because of a lack of information on the relative value of these pasture crops.

The purpose of this report is to furnish information on the comparative value of typical summer perennials and annuals based on Experiment Station grazing tests in 1958, 1959, and 1960. The Dairy Department at Mississippi State University compared Coastal Bermuda, Dallis grass, and Sudan grass pastures in this study. Tift Sudan was used in 1958 and Greenleaf in 1960. No Sudan was grown in 1959.

In general a uniform system of management was used for the three years work reported. Two to four two-acre paddocks of each pasture crop were used each year. The permanent grass paddocks were established in 1954 and 1955. The Sudan grass paddocks were in oats for winter grazing prior to seeding and the Sudan was plowed up by September 15 to allow seeding of oats for the next winter grazing period.

Maintenance applications of phosphate and potash were applied each fall on the basis of soil tests. Ammonium nitrate was split into three equal applications, the first being applied as a top dressing to the permanent pastures in the spring and to the temporary crops at planting. All pasture crops received 400 pounds of ammonium nitrate per season, with the exception of the irrigated crops in 1959 which had 500 pounds. The pastures were clipped 2 to 3 times per season to maintain optimum quality of forage.

The effect of irrigation on the amount and quality of forage produced was studied in 1959 and 1960. A sprinkler system was used and water was applied in 1959 to provide approximately two inches of rainfall and irrigation water each 10 days. However, in 1960 an estimate was made of plant available moisture in the upper 24 inches of the soil, plant water use, and evaporation loss. Irrigation water was applied as needed to insure a soil moisture level within the range between field capacity and 50% of the estimated plant available soil moisture capacity.

Each year milk production was measured in carefully controlled grazing trials using groups of selected "tester" cows. In four of the five trials reversal type designs of 63 and 84 days were used. The cows were rotated from one type of grass to another after 21 or 28 day periods according to the design of the trial. The non-irrigated study in 1960 was a continuous trial with 4 cows per treatment. Six "tester" cows per treatment were used each year in the reversal designs giving a total of 18 in 1958 and 1960, and 24 in 1959. In all of the trials the cows were rotated between two or more paddocks of the same grass to insure top quality grazing at all times. In addition to the "testers" other cows were used as necessary on each paddock to keep the grass grazed to the proper intensity.

Pasture productivity was measured in terms of the average total 4% milk yield per acre and by calculating the average total digestible nutrients (TDN) per acre harvested by the cows. Body weights were recorded on the third, fourth, and fifth days after the cows started grazing and on the last three days before they were moved from one paddock to another. These figures were used to determine any gain or loss of body weight. The cows were on pasture 18 to 20 hours each day. They were removed only for milking.

A simple 16% crude protein grain mixture was fed according to milk production at the rate of approximately one pound for each four pounds of 4% milk.

Forage Quality

The results of the trials designed to determine the quality of the three pasture grasses are summarized in Table 1.

In the three trials where Sudan grass was compared with the permanent grasses it supported a higher level of production. The cows grazing Sudan produced approximately 7% more milk daily than those on Dallis grass and 12% more than the Coastal Bermuda cows. They were also more persistent in production. Their average decline in production for the 4-week test periods was only 3.7% as compared to 11.6% for the cows on Dallis grass and 26.6% for the Coastal Bermuda cows.

Coastal Bermuda was compared with Dallis grass in 5 trials in the 3-year period of this experiment. Animals grazing Dallis grass produced more milk per day than those on Coastal Bermuda in each case except the non-irrigated trial in 1960 where there was no significant difference in production. The average daily production for the five studies was 33.3 pounds for the cows on Dallis grass and 31.7 pounds for the cows grazing Coastal Bermuda grass. The difference in average persistency of production was even more marked. The cows grazing Dallis grass were approximately 12% more persistent than those grazing Coastal Bermuda grass.

Total Forage Production

Coastal Bermuda has consistently produced more forage per acre than either Dallis grass or Sudan grass. Figures in Table 2 show that Coastal Bermuda grass produced approximately 34% more TDN per acre than Dallis grass and 48% more than Sudan. The 5 trial average of 4% milk produced per acre was 5,007 for Coastal Bermuda grass and 4,269 for Dallis grass. This difference in forage production is also reflected by the cow days grazing obtained per acre which averaged 222 for Coastal, 140 for Dallis, and 107 for Sudan, and by the total milk produced per acre which averaged 4,764 pounds for Coastal Bermuda, 3,764 for Dallis and 3,529 for Sudan.

Irrigation Increased Total Forage

Total forage production of all three grasses was increased by irrigation (Table 2). During the dry summer of 1960, milk production per acre was 35% greater on irrigated Coastal Bermuda than on non-irrigated. The difference was 70% on Dallis grass and 30% on Sudan grass. An average of 10.5 inches of irrigation water per acre was applied from May through August, 1960 (Table 3).

Approximately 5.0 inches more rainfall was recorded during the five-month summer period of 1959 than in 1960, therefore the effect of irrigation on forage production was not as great.

There seemed to be no significant difference in the quality of the forage due to irrigation. The only valid comparison of this is shown by the figures in Table 1 for the 1959 grazing trial comparing Coastal Bermuda and Dallis grass—both irrigated and non-irrigated. In this trial there was ample grass for the "tester" cows and there was no significant difference in average daily production or persistency of production between the irrigated and non-irrigated treatments within a grass specie. The 1960 figures for irrigated and non-irrigated cannot be compared so far as average daily production is concerned since the irrigated treatments were in a reversal trial and the non-irrigated in a continuous designed trial with different animals. Furthermore, grazing at times was limited in the non-irrigated trial due to drought.

An economic consideration of irrigation for pastures will not be presented due to the limited amount of data available from these studies; however, the increased cost of producing milk on the irrigated pastures is shown in Table 4. A charge of $2.50 per acre inch of irrigation water was charged to each pasture paddock involved.

Cost and Income

If the cost of irrigation is not considered, the yields obtained during the 5 trials from the three grasses may be regarded as representing "normal," dry, and wet years. Based on this principle, the average total feed cost of producing 100 pounds of milk during the three comparable years was $.93 on Coastal Bermuda, $1.18 on Dallis grass and $1.61 on Sudan grass (Table 4).

The total amount of forage produced per acre governs to a large extent the carrying capacity and therefore the total amount of milk produced per acre for pasture grasses. Pasture yields, therefore, have a marked effect on the cost of producing milk. The higher feed cost of producing 100 pounds of milk from the lower yielding Sudan grass was also in part due to the establishment cost of approximately $16 per acre which was charged to the feed cost for the Sudan pastures. No establishment cost was added to the maintenance cost of the permanent pasture grasses. The establishment cost for Coastal Bermuda or Dallis grass is relatively high and a pro-rated share should be added to the maintenance cost during the first 4 to 5 years.

As shown in Table 4 the average income above total feed cost calculated for the "tester" cows was $1.35 for Coastal Bermuda and Dallis grass, and $1.29 for Sudan grass with the milk sold on a Grade A market at $5.30 per hundred. When calculated at a Manufacturing milk price of $3.10 per 100 pounds the values would be $.67 for Coastal, $.64 for Dallis, and 0.52 for Sudan.

An economic comparison of these grasses may be made on the basis of a constant-sized herd. Based on average values for the three trials in which temporary and permanent grasses were compared, 22 acres of land would be required for a 40-cow herd grazing Coastal Bermuda during a 120-day season. These 40 cows would produce 1,483 cwt. of 4% milk. The same herd would require 34 acres of Dallis grass pasture and would produce 1,570 cwt. of milk, and 45 acres of Sudan grass pasture and produce 1,680 cwt. of milk.

At $5.30 per cwt. for 4% milk and an average feed cost of $0.93 for producing 100 pounds of milk on Coastal and $1.61 on Sudan the income above feed cost would be $6,481 for the 40-cow herd grazing Coastal Bermuda, and $6,199 for the cows grazing Sundan. The income above feed cost for the Dallis grass cows would be $6,468. However, the 22 or 34 acres of land in permanent pasture would be occupied for 12 months whereas the 45 acres of Sudan land would be free for a temporary winter crop.

Results of this study indicate that carefully managed Coastal Bermuda pasture used in connection with limited acreage of higher quality temporary pasture crops should fit well into the pasture program on some Mississippi dairy farms. However, milk production from Coastal Bermuda grass would be much lower than in the 5 trials of this study if the pastures were not carefully managed. A system of rotational grazing management wherein the early growth of Coastal Bermuda is grazed by the milking herd, followed by dry cows and yearling heifers seems to be the most desirable.

A further consideration must be given

Table 1. Quality of summer pasture forage as indicated by the performance of "tester" cows during trials in 1958, 1959, and 1960.

Year[1]	Coastal Bermuda				Dallis Grass				Tift or Greenleaf Sudan			
	Av. daily prod. per cow[2]	Persistency[3]	Daily body wt. change per cow	Grain: milk ratio	Av. daily prod. per cow[2]	Persistency[3]	Daily body wt. change per cow	Grain: milk ratio	Av. daily prod. per cow[2]	Persistency[3]	Daily body wt. change per cow	Grain milk ratio
	lbs.	%	lbs.	lbs.	lbs.	%	lbs.	lbs.	lbs.	%	lbs.	lbs.
(1) 1958 Non-Irr.	28.1	71.4	+.72	1:5.0	31.5	91.2	+.19	1:5.6	32.4	98.8	—.04	1.4.5
(2) 1959 Irr.	33.0*	83.4	—.03	1:3.0	34.0	87.1	—.57*	1:3.2	—	—	–	
(3) Non-Irr.	32.9*	84.9	+.53	1:3.0	34.2	89.6	—.62*	1:3.3	—	—	–	
(4) 1960 Irr.	35.0*	72.3*	—.28	1:3.5	37.5	93.4	—.45	1:3.3	40.2	98.6	—.30	1:3.6
(5) Non-Irr.	29.7	76.4	..	1:3.7	29.1	80.6	..	1:3.6	32.4	91.6		1:2.8
Av., lines 1, 4, 5	30.9	73.4	+.22	1:4.07	32.7	88.4	—.13	1:4.17	35.0	96.3	—.17	1:3.63
Av., lines 1-5	31.7	77.6	+.24	1:3.64	33.3	88.4	—.36	1:3.80				

[1] In 1958 data from irrigated paddocks was questionable due to high rainfall; therefore, results are not presented. Two different trials in 1960 reversal design for irrigated study and continuous design for non-irrigated study.

[2] 4% fat-corrected-milk.

[3] Average values based on the percentage change in production during each 28 day period.

*Significantly different from other treatment means in the same trial at .05 level of probability.

Table 2. Yields of milk and feed value and carrying capacities for irrigated and non-irrigated summer pastures.

Year	Coastal Bermuda			Dallis Grass			Sudan Grass		
	Milk prod. per acre[1]	TDN/A from pasture[2]	Cow days grazing/A	Milk prod. per acre[1]	TDN/A from pasture[2]	Cow days grazing/A	Milk prod. per acre[1]	TDN/A from pasture[2]	Cow days grazing/A
	lbs.	lbs.	days	lbs.	lbs.	days	lbs.	lbs.	days
(1) 1958 Non-Irr.	4543	3167	263	4347	2601	206	2235	1051	83
(2) 1959 Irr.	5707	2163	215	5567	1675	188	—	—	—
(3) Non-Irr.	5033	1843	160	4489	1557	134	—	—	—
(4) 1960 Irr.	5894	2875	236	5352	1862	152	4903	1608	136
(5) Non-Irr.	3856	1998	168	1592	843	62	3451	1556	101
Average, lines 1, 4, 5	4764	2680	222	3764	1769	140	3529	1405	107
Average, lines 1-5	5007	2409	208	4269	1708	148	—	—	—

[1] 4% fat-corrected-milk.

[2] Total digestible nutrients (TDN). A measure of the total feed value secured from pasture.

to persistency of production by dairymen concerned with high levels of daily production per cow. For example, based on the average persistency values of 73% for Coastal and 93% for Sudan, a herd averaging 45 pounds per cow at the start of the summer grazing period would average approximately 38 pounds per cow at the end of 100 to 120 days of grazing Sudan grass, whereas those on Coastal Bermuda would average less than 15 pounds per day.

Table 3. Monthly rainfall and average amount of irrigation applied to each irrigated paddock.

	1958	1959		1960	
Month	Rainfall	Rainfall	Irrigation	Rainfall	Irrigation[1]
			Inches		
May	4.62	6.10	-----	3.25	1.25
June	4.95	2.04	1.50	1.99	1.81
July	9.39	2.19	2.75	1.39	4.90
Aug.	2.50	2.50	3.00	2.79	2.54
Sept.	3.41	3.09	2.34	1.39	-----
Total	24.87	15.92	9.59	10.81	10.50

[1] Irrigation was discontinued during September, 1960.

Table 4. Cost and income figures for irrigated and non-irrigated summer pastures.

Year			Coastal Bermuda			Dallis Grass			Sudan Grass		
			Feed cost 100 lbs. milk[1]	Income above feed cost/cow/day[2]		Feed cost 100 lbs. milk[1]	Income above feed cost/cow/day[2]		Feed cost 100 lbs. milk[1]	Income above feed cost/cow/day[2]	
			$	Grade A	Mfg.	$	Grade A	Mfg.	$	Grade A	Mfg.
(1)	1958	Non-Irr.	0.92	1.23	61	0.94	1.37	.68	1.74	1.15	.44
			(1.59)[1]	---		(1.58)	—	—	—	—	—
(2)	1959	Irr.	1.17	1.36	64	1.15	1.41	.66	—	—	—
(3)		Non-Irr.	1.19	1.35	.63	1.25	1.39	.63	-----	----	----
			(1.29)			(1.46)	----	---	(2.08)	---	----
(4)	1960	Irr.	0.84	1.56	79	0.97	1.62	.80	1.54	1.51	.63
(5)		Non-Irr.	1.03	1.27	.62	1.64	1.07	.43	1.55	1.22	.50
			(1.08)			(1.35)	-----	---	(1.74)	----	---
Av., lines 1, 4, 5			0.93	1.35	.67	1.18	1.35	.64	1.61	1.29	.52
			(1.20)			(1.37)	------	---	------	----	---
Av., lines 1-5			1.03	1.35	.66	1.19	1.37	.64	---	---	

[1] Includes cost of concentrates fed and all seed, labor and fertilizer cost involved in the establishment of the temporary pastures and in the maintenance of permanent pastures. The figures in ( ) include the cost of irrigation at $2.50 per acre inch of water.

[2] Based on the average daily production of the "tester" cows, av. feed cost per cwt., and a price per cwt. of $5.30 for Grade A and $3.1 for manufacturing milk.